AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

▲ ▲ ▲

VOLUME 21. NEW YORK, THURSDAY, MARCH 31, 1898. NUMBER 13.

▲ ▲ ▲

Accurate Screw Machine Work.—Automatic vs. Hand Screw Machines.

BY J. O. SURFACE.

The question of the relative economy of automatic and hand screw machines is frequently discussed, though to one thoroughly acquainted with both there is little doubt of the saving by automatic machines when the work is made in suitable quantities. However, Mr. H. Austin, of Birmingham, England, in the issue of March 3, seems to question the quantity and quality of the product, and some practical results in this country may be of interest and value to him and other readers of the "American Machinist."

Of course, all automatic machines are not alike regarding speed of production and accuracy of product, and it is safe to say that nearly as much depends upon the operator of the machine and the designer of the tools as upon the machine, so far as quality of work is concerned. The very best machine with a poor set of tools and with the cams poorly designed or adjusted will make poor work. Some parts of the feed may be so fast as to require too frequent sharpening of the tools, making rough work and not within the gage limits. For an operator does not like to disturb a machine as long as he thinks the work will pass inspection. Then, if another part of the feed is too slow, the whole machine may be speeded up to get the product where it ought to be, dulling up the tools and producing rough work in consequence.

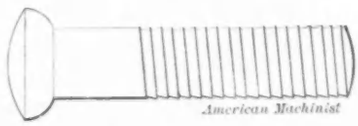
To operate to the best advantage, all cuts should be carefully proportioned, so that the tools will last about an equal length of time, and not require sharpening more than once or, at the most, twice a day.

Machines which have a set of cams for each screw or piece made are preferable, for if they are made correctly they can be put in the machine again with the certainty that they will produce equally good results and not depend on the skill of the operator.

Under proper conditions, more and better work should be made on automatic machines, because the feed is always regular, with no jerks. Who would expect to produce as good work feeding a lathe or planer by hand? And why expect better work from a hand-screw machine? An even, regular feed must have as much advantage in one case as in the other. There may be circumstances (such as using a small drill, when a skilled operator can match the drill for every hole and sharpen as often as needed) where a hand machine will do the most work, but such cases are a very small proportion of the work done on screw machines.

If the turrets revolve too slowly, as mentioned in the article referred to, it may be the machine is not properly belted up. Some machines in this country certainly revolve their turrets faster than hand machines. There is also the same saving in feeding stock.

Much, too, depends on the gages used for the work and the system of gaging employed. Too much stress cannot be laid on the value of limit gages, for nothing else is of so much assistance in getting out good work with different operators. A bright boy can feed stock in an automatic, and if in all cases the boy carefully gages a piece of work each time a new bar of stock is put in the work will be good, unless pieces are very short or feeds and speeds too fast.



A DIFFICULT SCREW.

One boy has in some cases attended to twenty-five machines, but this is doubtful economy, for the product per machine must be very low to allow this. In these cases a boy would be kept very busy running three machines, because of there being little work on each piece. A good system is to have one or more good men available, to grind and set tools, with bright boys to feed stock and test the work and, when not to the gages, shut the machine down till tools are adjusted.

The accompanying sketch shows a screw which gave a great deal of trouble on hand machines owing to the thread. its peculiar shape not leading the die on properly, and it was impossible for an operator to bring up the turret to just the correct speed. The angle of the thread is in this case 15 degrees from the axis of the screw. This was easily made on an automatic, because the cams were made to feed the die both on and off at just the correct lead. A similar result is usually obtained with the regular V thread, the size and pitch being more even on automatic machines. Many other examples might be shown wherein the product was better on automatic machines owing to the regular feed, and it is not an uncommon occurrence for an automatic to make from 50 to 100 per cent. more work. In one shop ten machines paid for themselves in less than eighteen months, and did the work of about twenty hand machines. In another shop one machine saved $30 a week over buying the screws. I have yet to see work which cannot be made at least as good on an automatic as on a hand machine, and certainly some pieces, for the reasons given above, can be done better.

▲ ▲ ▲

Quick Work.

In the inaugural address of President Webb, of the Manchester (England) Association of Engineers the following statements occur:

A firm of shipbuilders on the Clyde with "Mushet" steel drills, running at 300 revolutions, drill two holes per minute, 13-16 inch diameter, through steel plates 1⅛ inch thick, the drillings coming through so hot that strong paper is burnt when held underneath. They grind the drills three times in twelve hours. A firm at Bolton turn iron shafting 25.5 feet per minute, turning a shaft 3.25 inches diameter, 22 feet long, in one hour, turning a 32-foot rope pulley for forty ropes, 1½ inch diameter, in five days and five nights. A Glasgow firm finished a shaft 19 feet long, 15¾ inches diameter, one coupling, 31 inches by 3¼ inches, from the rough forging in thirty hours. They also bored a 90-inch cylinder at the rate of 2⅛ inches per hour straight through without stopping, the cutters being sharp at the finish. A 96-inch cylinder, at the rate of 3 1-16 inches per hour, feed six cuts to the inch.

Rights of Partners and Stockholders in Manufacturing Concerns to Patents on Inventions.

A reader of the "American Machinist," referring to the article in the issue of March 10, 1898, relating to rights of employers and employés to the latters' inventions, writes me requesting an answer in the "Machinist" to the following questions:

How is the right to an invention affected in the case of partners, and where one is a stockholder in a concern and uses the firm's tools and its time to construct any new device that he might desire to hold the sole right of the patent on? Would the partner or stockholder conceiving and perfecting the invention stand before the law the same as you cite for an employe?

Answer: Questions of this kind may arise in suits in the State courts over contracts, expressed or implied, as well as in the United States courts, where infringement is charged. As the State courts do not feel obligated to follow either the decisions of the courts of the United States or of other States, but look rather to the precedents and analogies of their own decisions, we cannot consider the law settled, in these cases, with that degree of certainty and universality that we look for in cases of infringement, which are decided only in the United States courts.

The following principles, however, are accepted by the courts of the United States and of the States of New York, Pennsylvania and Massachusetts:

If, during the continuance of a partnership, one of the partners conceives of an invention, and reduces it to practice at the firm's expense, with their tools, employés and materials, and obtains the patent at the expense of the firm, but in his own name, he is the sole owner of the invention and patent. The partnership is not the owner thereof. If, after dissolution of the partnership, the other partners use the invention they are infringers, and the courts will enjoin them.

If, however, when the invention is reduced to practice, it is used by the firm, with the tacit consent of the inventor-partner, an implied license to the firm to use the invention arises.

It has been decided in Pennsylvania that, in such a case, the other partners have a license to use the invention after dissolution and to the end of the patent term.

But this must be considered doubtful, and the better opinion is that in this case the license ends when the firm is dissolved, and the other partners have no right to use the invention after dissolution, except so far as the invention may be embodied in articles made before dissolution, and which were allotted to those other partners on the division of the assets.

Where an implied license to the partnership has arisen, that continues to the winding up of the firm. A receiver has a right to sell articles made by the firm and embodying the invention, and the purchasers of the articles have, of course, the right to use the invention as an incident to the use of those particular articles. The law also seems to be, at least in the United States courts, that where a partnership is not dissolved, but is converted into a corporation, which is rather the successor to the partnership than a new concern, the implied license passes over to the corporation.

The implied license is not, however, exclusive; the inventor remains the owner of the patent and invention, and may himself make, use and sell it, and license others to do so.

A mere stockholder in a corporation is in even more favorable position than is a member of a partnership, and certainly no stricter rule will be applied to his invention than is applied to the invention of a partner.

D. WALTER BROWN.

New York.

▲ ▲ ▲

The Proportions of Compound Air Compressor Cylinders to Secure Best Economy.—Economy of Compounding.

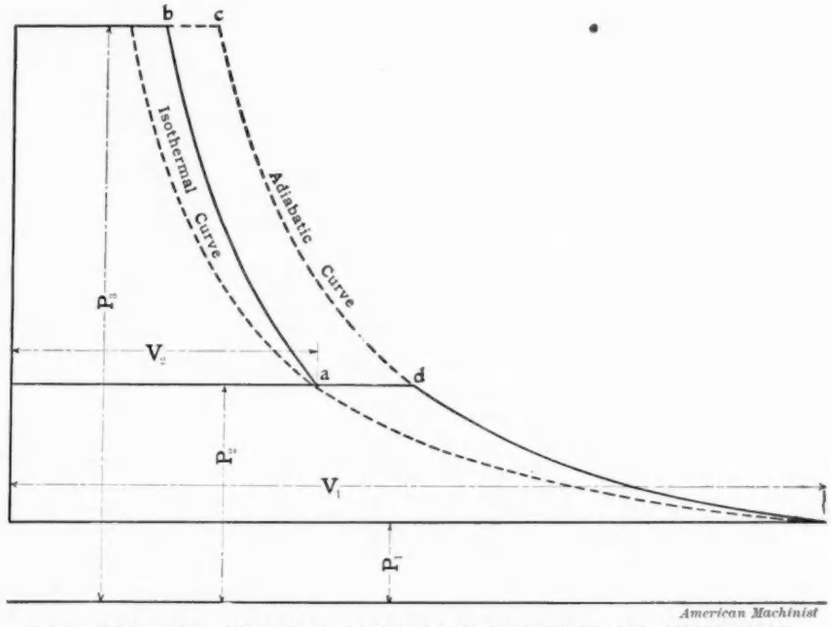
BY F. A. HALSEY.

As was stated in the article on the "Analysis of Air Compressor Indicator Diagrams," the common practice in proportioning compound compressor cylinders is to make them of such size as to divide the work equally between them. It was also stated that this principle is erroneous, the best proportion being stated to be that which should secure the maximum saving in power by the compounding.

I have held this view for some time without looking into the matter with a view of determining what these correct proportions are, but since writing the article on the analysis of air cards I have made this examination and have obtained the surprising result that from whichever standpoint the problem is viewed the resulting solution is the same—that is, that the proportion of cylinders which divides the work equally also secures the greatest saving possible from compounding. It is therefore necessary to take back the statement that equal division of the work is wrong, though not because of erroneous views but because of this coincidence.

The result is so curious that some of the readers of this paper may wish to see the demonstration, although most will pass it over, as it contains a little calculus.

The diagram represents an ideal combined indicator card from the cylinders of a two-stage compressor. The action of the intercooler is supposed to reduce the temperature of the air to that at which compression in the first cylinder began, so that the beginning of compression in the second cylinder falls at *a* on the isothermal curve. The compression in both cylinders is supposed to be adiabatic, as it practically is in all ordinary cases, and the adiabatic curve for the first cylinder has been extended upward. The



IDEAL COMBINED INDICATOR CARDS FROM COMPOUND AIR COMPRESSOR.

problem is to find the value of P_2, or the ratio between P_2 and P_1, such that the area *a*, *b*, *c*, *d* shall be a maximum. This obviously depends upon the area of the

two cards, and the same result will be obtained if the value of P_2 be found such as to make the sum of the areas of the two cards a minimum. Calling

$$\frac{P_3}{P_1} = R$$
$$\frac{P_2}{P_1} = r_1$$
$$\frac{P_3}{P_2} = r_2$$

W_1 = area of L. P. card or L. P. work per stroke.

W_2 = area of H. P. card or H. P. work per stroke, we have, as stated in the previous article,

$$W_1 = 3.45\ P_1\ V_1\ [r_1^{\cdot 29} - 1] \qquad (1)$$
$$W_2 = 3.45\ P_2\ V_2\ [r_2^{\cdot 29} - 1] \qquad (2)$$

From the property of the isothermal curve,

$$P_1\ V_1 = P_2\ V_2$$

Also as a matter of necessity,

$$r_1\ r_2 = R$$

or,

$$r_2 = \frac{R}{r_1}$$

and equation (2) may be rewritten,

$$W_2 = 3.45\ P_1\ V_1 \left[\frac{R^{\cdot 29}}{r_1^{\cdot 29}} - 1\right]$$

which may be made to read

$$W_2 = 3.45\ P_1\ V_1\ [R^{\cdot 29}\ r_1^{-\cdot 29} - 1] \qquad (3)$$

Adding (1) and (3) gives

$$W_1 + W_2 = 3.45\ P_1\ V_1\ [r_1^{\cdot 29} + R^{\cdot 29}\ r_1^{-\cdot 29} - 2] \qquad (4)$$

which is the sum of the areas of the two cards, and for which it is desired to find a value of r_1 such that the whole expression shall be at a minimum. Differentiating (4) and placing the result equal to o gives

$$3.45 \times .29\ P_1\ V_1\ r_1^{\cdot 29 - 1\cdot} + 3.45\ (-.29)\ P_1\ V_1\ R^{\cdot 29}\ r_1^{-\cdot 29 - 1\cdot} = o$$

which at once reduces to

$$r_1^{-\cdot 71} - R^{\cdot 29}\ r_1^{-1\cdot 29} = o \qquad (5)$$

Dividing by $r_1^{-\cdot 71}$ gives

$$1 - R^{\cdot 29}\ r_1^{-\cdot 58} = o$$

or,

$$\frac{R^{\cdot 29}}{r_1^{\cdot 58}} = 1$$

or,

$$r_1^{\cdot 58} = R^{\cdot 29}$$

or,

$$r_1 = R^{\frac{\cdot 29}{\cdot 58}} = R^{\frac{1}{2}} = \sqrt{R}$$

which is precisely the value of r_1 for equal division of the work—a result that is at once curious, useful and to me entirely unexpected. It is nearly obvious that this value for r_1 corresponds to a minimum for the total work, but the usual test shows it conclusively.

Differentiating (5) a second time gives,

$$-.71\ r_1^{-1\cdot 71} + 1.29\ R^{\cdot 29}\ r_1^{-2\cdot 29}$$

Since $r_1 = R^{\frac{1}{2}}$

this expression becomes

$$-.71\ R^{-\frac{1\cdot 71}{2}} + 1.29\ R^{\cdot 29}\ R^{-\frac{2\cdot 29}{2}}$$

which reduces to

$$-.71\ R^{-\cdot 855} + 1.29\ R^{-\cdot 855}$$

or,

$$-\frac{.71}{R^{\cdot 855}} + \frac{1.29}{R^{\cdot 855}}$$

It is obvious that for all possible values of R the numerical value of the second term of this expression must exceed that of the first, and the expression as a whole must, therefore, be positive and correspond to a minimum, and it may be considered as proven that for either equal division of the work or for the most economical compression, the number of compressions in each cylinder should be the square root of the total number of compressions—a fact which, so far as I know, has not before been noticed.

Equation (4) may be used to find the power consumed in compound compression, but the relation between R and r_1 enables it to be simplified.

Since

$$r_1 = R^{\frac{1}{2}}$$

equation (4) may be re-written by substituting $R^{\frac{1}{2}}$ for r_1

$$W_1 + W_2 = 3.45\ P_1\ V_1\ [R^{\cdot\frac{29}{2}} + R^{\cdot\frac{29}{2}} - 2]$$
$$= 3.45\ P_1\ V_1\ [2\ R^{\cdot 145} - 2]$$
$$= 6.90\ P_1\ V_1\ [R^{\cdot 145} - 1]$$

By dividing out the V_1 the work per stroke becomes the mean effective pressure, or

$$M\ E\ P = 6.90\ P_1\ [R^{\cdot 145} - 1] \qquad (6)$$

This equation gives directly the $M\ E\ P$ for compound compression, reduced to the low pressure cylinder, from the initial pressure and the total ratio of compression, the cylinders being supposed to be proportioned in accordance with what has gone before, and the intercooler being supposed to reduce the temperature of the air to that at which compression began. It is in the simplest form in which I have seen this matter put. It is similar in form to equation (7) for simple compression given in the article on air cylinder cards, and by its use the calculations for compound compression are no more laborious than for simple compression. Like the equation for simple compression the chief labor in its use is the logarithmic calculation of $R^{\cdot 145}$ and to shorten that labor the accompanying table has been calculated. It gives values of $R^{\cdot 145}$ from 5 to 15 compressions. As with the corresponding table for simple compression, the mean effective pressures from 14 pounds initial have been included—it being understood that in the present table these mean effective pressures are the equivalent pressures reduced to the low pressure piston. The two tables overlap in a portion of their range, and for this overlapping region a column has been added to the present table, which compares the mean effective pressures for the two systems from 14 pounds initial, and gives the ultimate saving possible from that initial pressure by compounding. The region in which the comparison is made covers about all the cases in which there would be any question as to the advisability of compounding. Below the overlapping portion of the tables few would consider compounding worth while, and above it compounding is almost a necessity from mechanical considerations, and quite apart from the question of saving power by the intercooler.

$\frac{\text{Final pressure}}{\text{Initial pressure}} = R$	$\left(\frac{\text{Final pressure}}{\text{Initial pressure}}\right)^{.145} = R^{.145}$	$M\ E\ P$ from 14 pounds initial reduced to low pressure cylinder.	Ultimate saving by compounding per cent.
5	1.263	25.4	11.5
5.5	1.280	27.0	12.3
6	1.296	28.6	12.8
6.5	1.312	30.1	13.2
7	1.326	31.5	13.7
7.5	1.336	32.8	14.3
8	1.352	34.0	14.8
8.5	1.364	35.2	.....
9	1.375	36.3	.....
9.5	1.386	37.3	.....
10	1.396	38.3	.....
11	1.416	40.2	.....
12	1.434	41.9	.....
13	1.451	43.5	.....
14	1.466	45.0	.....
15	1.481	44.4	.....

Table for finding mean effective pressures of air compressed in two stages, assuming the intercooler to reduce the temperature to that at which compression began.

The combined air cards, Fig. 1 of the previous article, show that the intercooler, if well designed, may be expected to realize this saving, as it is only necessary for it to cool the air to the initial temperature, which was shown to be accomplished with the machine from which the cards were taken. There is no reason in fact why at times still better results should not be realized, and with a supply of extra cold water that is sometimes the case. There is, however, a loss to offset a portion of the gain. This is shown by the overlapping of the high and low pressure cards combined in Fig. 1 of the previous article, which is due to the resistance of the low pressure discharge and high pressure inlet valves and of the passages connecting them. It is obvious that this cannot be reduced to zero, but how small it may be made in any case depends on the design of the ports and passages as regards the resistance they offer to the passage of the air. The table takes no account of this loss, but credits the compound compressor with the entire saving due to the intercooler. There is another source of saving due to compounding, of the importance of which very little is known. The heating of the air by compression soon imparts heat to the cylinder walls, and in spite of the cold water jacket there can be no doubt that the inner surface of the cylinder liner is materially warmer than the incoming air. The effect of this is to warm and expand the air before compression begins, in consequence of which less air is taken in than would be the case if this action were absent. The division of the compression between two cylinders results in the first cylinder being heated to a less degree

than in single cylinder machines, and the warming of the air before compression begins must be correspondingly reduced. As stated, however, very little is known regarding the magnitude of this action. It may be important or the reverse, and which it is can only be determined by experiments, which it is to be hoped will be made on the compressors recently added to the equipments of some of our engineering schools. If the action should be found to be important it might modify the conclusions arrived at in the first part of this article. It might easily happen that by reducing the pressure made by the low pressure cylinder more would be gained through the reduction of the initial warming of the air than would be lost by throwing the cylinders out of balance.

Still another gain from compounding not taken into account in this table grows out of the reduction of the clearance losses. The air which fills the clearance spaces at the completion of the stroke re-expands on the succeeding return stroke and, until it expands to atmospheric pressure, no fresh air is drawn in—the effective stroke being shortened by the portion of the stroke occupied by the re-expansion. This portion of the stroke is obviously greater for high receiver pressures than for low, and as compounding reduces the pressure made by the low pressure cylinder it reduces this loss. The clearance of the high pressure cylinder has no effect on the amount of air delivered, as, plainly, the air put through the first cylinder must go through the second. The effect of the clearance of the high pressure cylinder is to slightly disturb the intercooler pressure and the balance of work between the two cylinders.

The recent explosions of air receivers, due to the vaporizing and subsequent spontaneous ignition of the lubricating oils, gives added value to compound compressors from their increased safety due to the lower temperature of the air as discharged to the receiver. Attention has already been called to this in these columns, but when the number of explosions is compared with the number of compressors in use, the great majority of which are not compounded, the danger with a single stage machine is obviously small, and it is quite possible may be removed entirely by oils better adapted to the conditions.

▲ ▲ ▲

At the Sportsmen's Exhibition recently held in this city there was shown in connection with the Savage rifle a sheet of steel ¼-inch thick with the outline of an Indian's head, somewhat larger than life size, formed by holes shot through it by a rifle at 20 feet distance. The holes were very accurately placed, so that the lines had a smooth flow, and the perforations were as clean as if punched.

The Determination of the Size and Number of Turns of Wire in a Constant Speed Motor.

BY WILLIAM BAXTER, JR.

In a previous article the principles of operation and the winding of the wire on constant potential generators was explained, and from a comparison of the diagrams accompanying that article and Figs. 1 and 2 here presented, it will be seen that there is no difference between them, so far as can be determined by a rather careful scrutiny; but, notwithstanding that, the present diagrams represent the winding of constant speed motors. It might be inferred from this that there is a great similarity between constant potential generators and constant speed motors, and the inference would be correct, for as a matter of fact, they are identical in everything except the name. If the machine is driven by power from any source it is a generator and an electric current can be obtained from it. If a current is passed through it, it becomes a motor and will furnish power for any required purpose. If it will develop a constant pressure when running as a generator at a constant velocity it will run at a constant speed when acting as a motor, providing it is supplied with a current of constant pressure. The only difference between Figs. 1 and 2 of this article and those of the article on generators is in the direction of the current through the various parts. If Fig. 1 represented a generator, the current coming from the armature would divide at the point *B*, one part flowing up to *N*, and the other down through the coils *S S*. When the figure represents a motor the current comes into it through wire *P* and it divides at *E*, part going through the coils *S S* and part through the armature, the two currents coming together at *B* and thence passing to wire *N*. In the motor the action of the armature is the same as in the generator; that is, it develops a pressure; but this pressure in the case of a motor is opposed to that of the current that drives the motor; it is a back pressure. If the pressure of the current supplied to the motor remains constant, the pressure at the points *E B* will be constant, and the current through the coils *S S* will not change; hence the back pressure set up by the armature will be directly proportional to the velocity. If the resistance of the

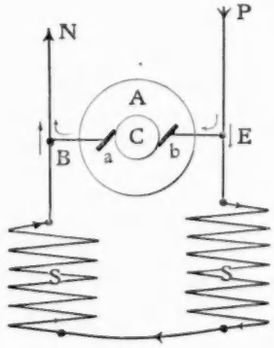


Fig. 1

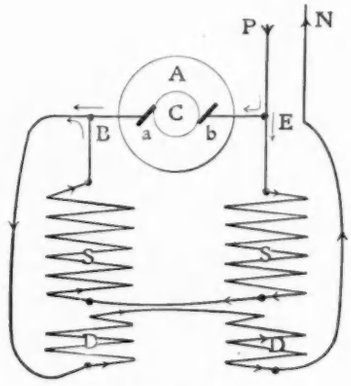


Fig. 2

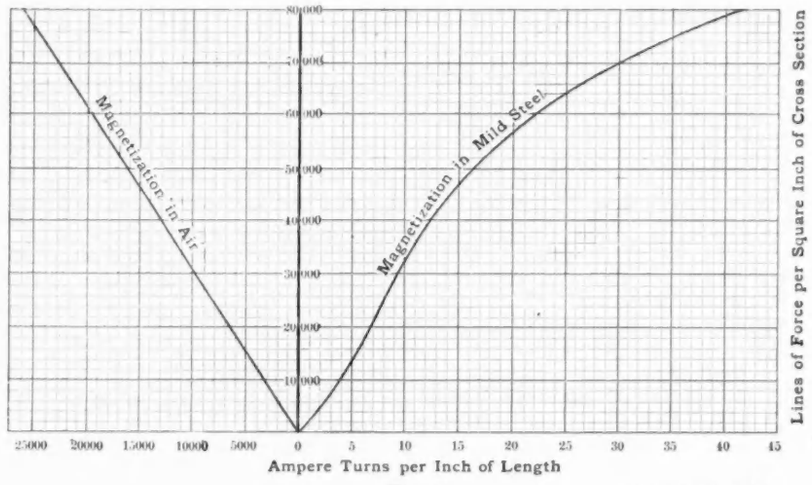


Fig. 3

WINDING A CONSTANT SPEED MOTOR.

armature is very low the back pressure will vary but a trifle with wide variations in the strength of the current, for the reasons set forth in the article on generators; but this fact can be made still clearer in this connection by an illustration. Suppose the resistance of the armature is one one-hundredth of an ohm, as in the example in connection with generators; then, if the current through the armature is 10 amperes the pressure required to drive the current through it will be one-tenth of a volt, and the back pressure will be 99.9 volts. If the current is 100 amperes the pressure required to overcome the armature resistance will be 1 volt and the back pressure 99 volts. Thus we see that while the current is increased ten times the back pressure has only been reduced nine-tenths of a volt; therefore, the speed of the armature will be reduced less than 1 per cent. When the current is 10 amperes the power developed by the motor will be about 1 1-3 horse-power and when the current is 100 amperes it will be about 13 horse-power. The low figures may be taken as the power developed when the motor is running light, and the latter as the power when at full load, and then we find that the difference in speed between the two extremes is less than 1 per cent.

In the case of the generator it was shown that when the pressure appearing at the brushes was reduced the current through the coils *S S* would also reduce, and that this would cause an additional reduction in the pressure. In the motor this action does not take place, for the pressure at *E B* is not changed by the increased loss of pressure in the armature with an increased current.

When the current passing through the motor increases, the loss of pressure in the lines leading from the generator to the motor increases, and this causes the pressure at *E B* to drop. The compound winding of the generator is for the purpose of compensating for this line drop, but it does not accomplish the result perfectly in every case; therefore, if the motor is not so made as to compensate within itself for changes in pressure at *E B* it will not run as near to a constant speed as the foregoing illustration would indicate. The compound winding which enables the generator to compensate for loss of pressure in the line also enables the motor to compensate for changes in pressure at its terminals. This winding when the machine becomes a motor is called differential winding, because the current passes through the series coils in the opposite direction to that through the shunt coils, and its effect is to reduce the strength of the magnetism of the field, instead of increasing it, as in the generator. It is not necessary to make any changes in the connections of the wires to cause the current to flow through the shunt and series coils in opposite directions. As can be seen, if the pressure starts in the armature the current will pass through the *S S* coils from *B* to *E*, but when the current comes from the external circuit the direction will be from *E* to *B*.

The speed of a constant potential motor, and the pressure of the current of a constant potential generator is dependent, primarily, upon the magnetizing capacity of the coils *S S*. The series coils *D D* play the part of regulators, compensating for the comparatively small variation caused by the loss of pressure in the line and armature wire. If a motor, or a generator, is to run at a given velocity, the shunt coils must be proportioned accordingly. To determine the size of wire to use for these coils it is necessary to know how strong the field magnetism must be. The strength of the field magnetism is measured in lines of force, and is expressed as so many lines per square inch of cross section. When we know the number of lines per square inch required in the field, we can determine the size of wire for the *S S* coils, because there is a definite relation between the current circulating around a magnet and the number of lines of force developed thereby. If the magnetic circuit is composed wholly of iron or steel, the lines of force developed by a given current will be vastly greater than if the circuit is wholly in air, because air resists the passage of magnetism to a much greater extent than ferric metals. If the magnetism is low the difference is as high as two thousand to one in favor of iron. As the magnetization increases the difference becomes less, but is not much under four or five hundred to one for any density ordinarily used. The lines of force developed by a current circulating around a magnet are the same per square inch of cross section whether the core is large or small, but are not the same for different lengths of magnetic circuit. The magnetizing capacity of the current is measured in ampere turns, an ampere turn being one ampere passing around the coil once. A coil having ten turns of wire would have a capacity of ten ampere turns if the current passing through it were one ampere, and one hundred ampere turns if the current were ten amperes, etc. If the length of the magnetic circuit is doubled, the ampere turns must be doubled; if it is increased ten times, the ampere turns must be increased ten times; but in making these increases account must be taken of the character of the circuit; that is, whether it is all iron or all air or part of each. If it is part air and part iron both parts must be increased or decreased in proportionate amounts to cause the ampere turns to change in like ratio. This can be made clear by means of the diagram, Fig. 3, and an illustration in connection therewith. This diagram shows the number of ampere turns per inch of length of magnetic circuit required to magnetize steel, of the kind used in electric machinery and air to different densities. The ampere turns are marked at the bottom and the lines of force per square inch of cross section on the vertical line. Suppose we have a motor that is to be magnetized to a density of 50,000 lines per inch. From the diagram it will be found that for each inch of length of the metal part of the magnetic circuit about sixteen and a half ampere turns will be required, and for the air part about 16,500 per inch. If the air part is half an inch the ampere turns for it will be about 8,250, and if the iron part is 50 inches the ampere turns for it will be $50 \times 16.5 = 825$, making a total of 9,075.

Having ascertained the number of ampere turns required, the size of wire for coils, *S S*, can be determined easily by remembering that one volt of pressure will drive through a wire of one ohm resistance a current of one ampere; therefore the number of feet of any size wire required to make a resistance of one ohm may be called the ampere feet capacity of the wire. Now, as the average length of wire for a turn in the coil can be easily determined, the number of ampere turns any wire will give for each volt of pressure can be found at once, and this multiplied by the pressure of the current will give the total ampere turns. To illustrate: Suppose we have a coil of such size that the average length of a turn is 2 feet, and suppose we require 5,000 ampere turns, and that the current pressure is 100 volts. Since the number of ampere turns is 5,000 and the pressure 100 volts, the ampere turns per volt are 50, and as each turn is 2 feet long, the wire required must have $50 \times 2 = 100$ feet per ohm.

Having determined the size of the wire, the amount to be wound on the coil is decided upon by the efficiency or amount of energy we are willing to expend in magnetizing the field. Suppose the machine is to give 100 amperes at full load, and that we conclude to use five amperes for the field, then the resistance of the coils must be 20 ohms, as 20 ohms $\times$ 5 amperes $=$ 100 volts. As the wire will make 50 turns per ohm, the total number of turns will be $50 \times 20 = 1000$, which, multiplied by 5 amperes, equals 5,000 ampere turns, and the length is 2,000 feet. Having found the number of turns, the space they will occupy can be ascertained from the following table, which gives the number of wires of different sizes per square inch of cross section of coil:

Gage No.	Turns Per Square Inch.
6	36
7	45
8	55
9	64
10	81
11	115

Gage No.	Turns Per Square Inch.
12	140
13	165
14	200
15	270
16	320
17	370
18	450
19	550
20	710
21	840
22	1000
23	1190
24	1690
25	1830
26	2590
27	2790
28	3180

NUMBER OF TURNS PER SQUARE INCH OF CROSS SECTION OF DIFFERENT SIZES OF WIRE.

The number of turns in the series coils is found by dividing the ampere turns required in them by the current capacity of the machine. The number of ampere turns in the series coils is ascertained in the same manner as in the case of the shunt coils, by making them of sufficient capacity to raise the lines of force per inch from the number required when the armature current is weak to the number required when it is at the maximum strength. The size of the wire for the coils and the number of turns should be determined by calculation when a machine is designed so that the space provided for the coils be sufficient, and at the same time not far in excess of actual requirements; but if it is desired that the machine produce a given result at a certain speed, it is safest to make the final determination of the size of the wire, experimentally, as explained in the article on generators, as the calculations, even if carefully made, with proper allowances for all interfering actions, are liable to be several per cent. out of the way.

The compound and differential winding can be made to compensate for drop in pressure at full load, but at intermediate points the compensation will not be perfect owing to the fact that the magnetization does not vary directly as the current.

▲ ▲ ▲

A Cheap Arrangement for Cooling Condensing Water.

Perhaps as cheap an arrangement as has ever been used for cooling condensing water is to be seen in operation at the works for the construction of the Jerome Park Reservoir, in this city. As is well known, an extensive system of compressed-air power transmission is employed for driving the rock drills, hoisting engines, pumps, etc., which are distributed over an area of a square mile or more, two large Ingersoll-Sergeant cross compound condensing Corliss compressors supplying the air. Water is, of course, accessible in sufficient quantity, but it is still desirable to be as saving of it as possible, and therefore the cooling arrangement referred to is employed. As the water is discharged from the air pump it is delivered into a flat chute, made of rough boards, say, 4 feet wide and 100 feet, or more, in length, with a slight pitch, so that the water spreads in a thin sheet over the entire surface of the chute, and at the end it falls successively over three or four horizontal platforms, or trickles through from one to the other, finally collecting in the main pond where the supply of water is maintained. A steam pump lifts the water from this pond to a smaller one, from which the condensers draw it. The cooling chutes and platforms represent the cheapest kind of carpenter work, and the cost of construction is slight, while considerable cooling of the water is certainly effected with a corresponding saving in the total volume required.

▲ ▲ ▲

Relative Economy of Gas Engine and Electric Motor for Shop Driving.

The following by Mr. A. R. Bellamy, of Messrs. J. E. H. Andrew & Co., Limited, Reddish, England, will be of interest to many of our readers for its practical information on shop practice:

"The machine which drives our shop is one of our modern 'Stockport' gas engines, working with fuel gas, and is capable of giving a maximum of 35-brake horse-power. The power to drive the engine itself with main belt, 40 feet long by 9 inches wide, running on loose pulleys, is 6.2 horse-power. This would be considered the friction load of the engine. The power absorbed in driving the following shafting is 8.6 horse-power, viz.: 532 feet of line shafting in two long straight lengths, ranging in diameter from 3½ inches to 1¾ inches, and with 80 bearings; together with 362 feet of countershafting, in 73 lengths, with 160 bearings; and 2,000 feet of belting ranging from 2 inches to 5 inches wide. We have the following tools in constant use, viz.: 4 fly-wheel and pulley turning lathes, 3 crank lathes, 8 planing and shaping machines, 3 cylinder boring lathes, 9 drilling machines, 5 milling machines, 4 capstan lathes, 33 lathes, average 10-inch centers (20-inch swing); 8 machines, various; 7 grinding and emery stones, making a total of 84 tools. The actual power absorbed by the tools, working under ordinary conditions, is 14.4 horse-power. The greatest maximum load that we can put on the engine, that is by starting up some of the heaviest tools altogether, is 22 actual horse-power. At the same time, we have in our works six machines that we know take about a three-brake horse-power engine to drive each of them under their worst conditions, and we have six others that take 2 horse-power each.

"Summarizing the whole matter, our engine takes 6.2 horse-power to drive itself with the main belt. The whole of the shafting, countershafting and belts, absorb 8.6 horse-power, and the tools themselves absorb 14.4 horse-power. Supposing that we were to put in electric motors to drive each individual machine, we should have to put in 80 electric motors, six of them would have to be not less than 3-brake horse-power each, and six of them not less than 2-brake horse-power each, in order to start the machine, under certain conditions; and we should have to drive the whole of these 80 motors for not more than 8.6 horse-power, to be equal to what we are doing at the present. Apart from this, we should have to put down a motor somewhat larger than the actual power required for each machine, so that I am confident instead of saving anything we should lose considerably in friction loss, driving with motors as compared with our present system. I think our own shop is a splendid example of the value of gas engines for driving our class of plant, where such plant is grouped together as we have it."

The above was quoted by President Webb, of the Manchester (England) Association of Engineers, in his recent inaugural address.

▲ ▲ ▲

Military Telescopes for Sea-coast Defense and Gun-boat Use.

A new range finder for seacoast defense gun batteries is under construction by Warner & Swasey, of Cleveland, Ohio. It employs two concealed telescopes, one on each side of the battery as usual, but avoids the delay due to the present method of laying down the angles of the telescopes in order to determine the location of the target. The swinging arms or rulers of the usual apparatus are replaced by rays of light which are kept constantly parallel with the axis of the telescopes, the rays of light and the telescopes moving together and indicating constantly the position of the moving target. These indications are read at the gun and determine its setting for range and elevation. In the case of guns mounted on disappearing carriages, they are thus aimed before elevation to the firing position, both observers and gunners being out of sight of the enemy. When ready for firing the gun is raised above the parapet, fired and returned to its concealed position, ready for loading again. The finder is the invention of Albert C. Crehore and Lieut. G. O. Squir, and large expectations are held regarding its value. Warner & Swasey are also making for the Government a hundred finder telescopes for direct attachment to large guns and twenty sextants for gunboat use.

A New Steam Separator.

The accompanying cuts show a new style of steam separator possessing some points of interest. These separators are made for either a vertical steam pipe, with a descending steam flow, as in Fig. 1, or for a horizontal pipe, as in Fig. 2, the features of operation being similar in either case. The object of the designer has been to secure as great efficiency as possible in the separation of entrained water from the steam, with the least obstruction to the flow. As will be seen the steam inlet gradually enlarges into a chamber of ten times the area of the

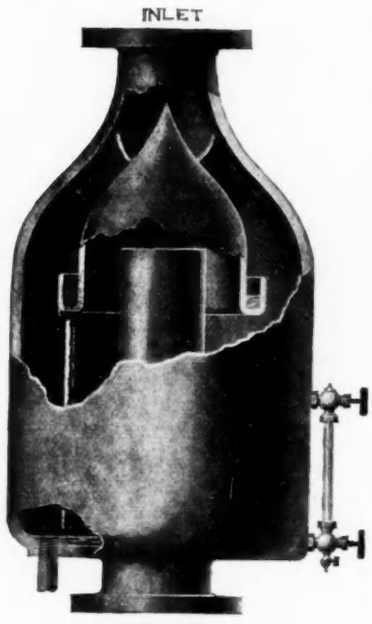


FIG. 1.—VERTICAL SEPARATOR.

pipe, and is then gradually reduced to the original area. No baffle plates or other obstructions are employed, the steam is not required to take on any centrifugal, zigzag or tortuous motions, and the interior of the separator is free from sharp corners or depending ledges, and is throughout as smooth as possible.

The principal feature of the separator is the interception of the entrainment by gutters which are kept partially filled with water. It has been found that by keeping these gutters or channels thus partially filled all entrained water or oil is effectually cut off, the channels being arranged to guard both the inlet and the outlet of the separator.

In the vertical separator, Fig. 1, the steam entering at the top strikes the exterior of the hollow cone, spreading all around it, the water and oil being caught in the gutter formed by the upturned lip. An overflow pipe stands at about one-half the hight of the lip, thus keeping the gutter half full, the surplus descending the pipe to the bottom of the main body, whence, by the pipe shown, it may be trapped or drawn away in the usual manner. The steam descends into the large lower chamber and turns upward inside the cone and down the large central pipe.

In the separator for horizontal pipes, Fig. 2, the steam may enter at either

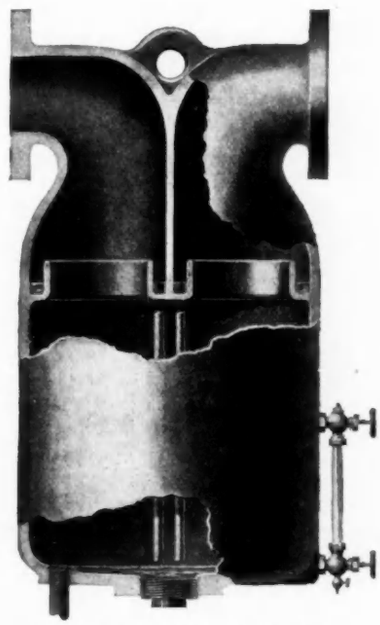


FIG. 2.—FOR HORIZONTAL PIPES.

flange, both sides being alike. As it descends it passes one of the gutters and as it ascends on the other side it passes the other. Fig. 3 is a section at about the top of the overflow pipes, showing the dividing partition and the gutters. The water gages show when it is necessary to draw off the water, if automatic means are not provided. All separators for pipes above 8 inch are made from flange steel. The dimensions and pipe connections may be varied to suit special conditions. The makers are the Hoppes Manufacturing Company, Springfield, Ohio.

▲ ▲ ▲

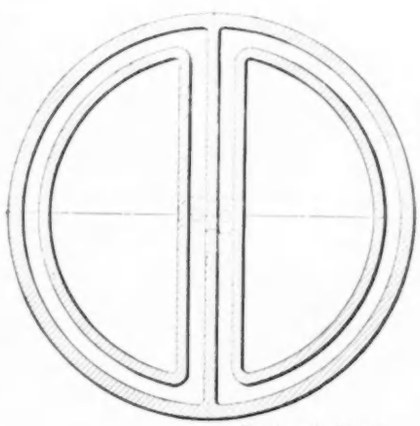


Fig. 3

CROSS SECTION SHOWING DRAINING PIPES.

The Metric System in England.

A press despatch, dated London, March 17, says: "The Association of the Chambers of Commerce of the United Kingdom, at its final meeting to-day in the Whitehall rooms of the Hotel Metropole, Sir H. Stafford Northcote, M. P., presiding, adopted the following resolution, introduced by the Chamber of Commerce of Leeds:

"'That in the opinion of the association the compulsory adoption within some limited period of the metric system of weights and measures, legalized by the act of last session, be advocated by every possible means, with the view of inducing Her Majesty's Government to afford facilities for the amendment of the law in this respect, and that a copy of this resolution be sent to the president of the Board of Trade and to the First Lord of the Treasury.'

"The meeting also adopted a resolution as follows: 'That this association, believing the absence of an official parcel post between Great Britain and the United States of America to be detrimental to the commercial relations of the two countries, request the Executive Council to memorialize Her Majesty's Government, urging renewed exertions toward the early establishment of such a service.'

"A resolution on the 'Language of Commerce,' introduced by the Chamber of Commerce of Leicester, was then adopted. It read:

"'That the Executive Council be requested to approach Her Majesty's Government, by deputation or otherwise, with a view of obtaining their co-operation with the American Government for bringing about uniformity in the spelling and meaning of English commercial language.'"

▲ ▲ ▲

The annual report of the President of the Tennessee Coal, Iron & Railway Company asserts that Birmingham, Ala., is the third largest exporter of pig iron in the world, being surpassed only by Middlesboro, England, and Glasgow, Scotland. The entire shipment of pig iron to foreign countries, outside of the American continent, from July 1, 1896, to January 1, 1898, amounted to 303,996 tons, or about 16,333 tons per month.

▲ ▲ ▲

We notice that several of our contemporaries which have the foreign edition fever are altering their spelling to suit British ideas, and have it "labour," "colour," "honour," "armour," etc. They speak also of "masters and men" and of "the labouring classes." We have considerable circulation in Great Britain, but those who read the paper there seem to be satisfied to accept it as it is, *i. e.*, an American journal.

The Stimulus of the Patent.

The annual report of the Commissioner of Patents, some reference to which appeared in our last issue, contains so much of interest that our readers will welcome some additional abstracts of its contents.

The most striking and important feature of the Centennial Exposition at Philadelphia in 1876 was its display of the improvements in industrial arts brought about by American invention. It was believed by many that the inventions there exhibited represented the highest development possible; that there was no further room for improvement in many of the arts at least. Yet the effect of this exposition was not, as might have been expected, to discourage invention or to convince inventors that nothing more remained to be done, that the field of invention was exhausted, but rather to largely stimulate inventive activity.

All of the inventions displayed at the Centennial, and all of the inventions for which patents were taken out in the four years following, are now public property. Included in these are inventions of the highest industrial and commercial value. The dynamo and electric motor, the cotton-gin, the sewing machine and many other inventions of almost equal effect in revolutionizing important industries are, in the form in which they were made and used prior to 1880, uncontrolled by patents, and may be freely made, used and sold by anyone. The influence of these inventions in the development of industries and the increase of employment cannot be doubted. They had much to do with the increase of manufactures from 123,025 establishments, with aggregate capital of $543,245,351 and employing 958,079 persons, in 1850, the earliest census in which a distinct report on this subject is presented, to 253,502 establishments, with aggregate capital of $2,780,766,895, employing 2,700,732 persons in 1880. The further increase to 322,638 establishments in 1890, with aggregate capital of $6,139,397,785 and employing 4,476,884 persons, is to be noted in this connection.

But the influence of patented inventions is most strikingly shown in the creation of new industries of enormous magnitude since 1880—that is, within the term of patents now in force or but very recently expired. Of these new industries the most noted are those directly connected with the development of electrical inventions, such as the manufacture of electrical apparatus and supplies, the supplying of electricity for lighting and power purposes, electric railways and the telephone. The manufacture of electrical apparatus and supplies began to be of importance shortly before 1880, and in that year seventy-six establishments, employing 1,271 persons and producing an output valued at $2,655,036, were in existence. In 1890 the number of establishments had increased to 189, employing 9,485 persons and reproducing an output valued at $19,114,714. The increase in this industry has been very large since 1890.

Though no separate statistics are given for the basic-steel process, by which steel free from phosphorus and therefore capable of being worked cold, is produced, there can be no doubt that this process, invented not long prior to 1880, and first extensively used in that year, has had much to do with the large increase of the production of steel and its use for tubing and structural purposes. The manufacture of iron and steel in 1880 employed 140,978 persons; the same industry in 1890 employed 152,535 persons.

Nor are these all of the new industries which have grown up in the period since 1880. The linotype machines, automatic weighing machines, etc., all represent industries of very considerable importance, in which millions of money are invested and many hundreds of men are employed.

It is to be noted with respect to the new industries based on patented invention that none of them were immediately successful. The public is not quick to accept new inventions until their practical value has been amply demonstrated. The electric light was believed impracticable, and in its first installations was met by practical difficulties hard to be overcome. The cash register and cash carrier met with serious opposition at first, and it was years before the bicycle was made acceptable to the general public.

None of the inventions on which these new industries are based were, in the form in which they were first patented, commercially practicable. Even if it be conceivable that the primary inventions would have been made without the stimulus of the patent system, there would have been no inducement to inventors to spend time and money in perfecting and improving these inventions without the certainty that if made practicable and acceptable to the public their manufacture, use and sale could be controlled for a term of years through the protection afforded by patents. If a new device may be freely copied by rival manufacturers as soon as it appears upon the market, no one can afford to expend the large sums of money which are often found necessary in perfecting the invention, in constructing the plant necessary for its manufacture and in bringing it before the public. It is stated that a new form of sewing machine for a special use cost in the preparation of jigs, dies and other facilities necessary for the economical manufacture of its parts upward of $50,000 before a single machine was ready for sale. But for the fact that the manufacturers had the assurance of an exclusive right to manufacture this machine through their ownership of the patents granted for the inventions which it embodied no such sum could have been expended, and the public would have had to be content with the inferior machines previously on the market.

To the stimulus afforded by the Patent Office is due the creation of these new industries and the very great development of recent years in the older industries. It is to the stimulus to invention given by our patent system that the great increase in our exports is largely due, and it is on American invention, as fostered and stimulated by the patent system, that we may confidently depend for ability to maintain the high rates of wages paid to American workmen and yet to compete successfully in the markets of the world with nations where the workman receives but a meager return for his labor.

▲ ▲ ▲

The Equities of Dealing with European Agents and American Commission Houses.

A question which has arisen as a proximate result of the present export movement in machine tools, and upon which strong difference of opinion exists between those who are vitally interested in it is: To what extent and just how shall a manufacturer protect his European agents?

The conflict of interests comes about in this wise: The firm Messrs. Doe & Roe are tool builders in Worcester or Cincinnati, having an agency in Berlin covering the whole of Germany. Mr. Coe is a New York commission merchant and dealer in machinery. He receives from Dresden an order for a Doe & Roe lathe, and writes immediately to the factory of the said firm to know whether it can be filled. The firm wish to know the destination of the lathe, and either he is honest enough to tell them or otherwise they suspect that it is intended for reshipment to Germany. Consequently they refuse to fill the order unless it be agreed that the lathe shall be kept out of that country. Of course Mr. Coe feels injured, and Messrs. Doe & Roe feel virtuous in their fidelity to their foreign agent.

Now, which has a right thus to feel? This depends in part upon the precise circumstances of the case. It goes without saying that if Doe & Roe have given their agent the exclusive sale of their tools in Germany they are bound to exercise due diligence at least in protecting him. Whether they are bound to inquire the ultimate destination of every tool sold, or to "ask no questions for conscience's sake;" whether to send around a list of their inviolable agencies, as one machinery company is said to do, or, perhaps, to preserve the sacredness

of the apportioned ground at every hazard—all this must be determined by the mutual understanding of the contract between themselves and their agent. It is true that two or three of the companies that have been most succcessful with their European trade are those which protect most faithfully their foreign representatives, and the statement is made that more devoted service is obtained on that account.

But it appears that the majority of concerns do not attempt vigorously to defend the fields of their foreign agents against hostile invasion by their own tools; and it may be asked: Would it be better policy for them to establish exclusive agencies, or, in the absence of any express or implied agreements with their representatives, how far ought they to allow their tools to be sold through other media?

There are a number of things that may be said in favor of a policy of comparative liberality toward outsiders in this particular. In the first place, it seems to have the sanction of most manufacturers. In the second place it is commendable upon patriotic principles, for selling is as legitimate a function of industry as any other, the seller being honestly entitled to his profits, and it is more meet that the domestic commission dealer should receive them than the foreign agent.

Again, from practical considerations, there is less reason for exclusive agencies in Europe than in America, although as a matter of fact we are told that most domestic agencies are not exclusive. In this country the field is relatively small, permanent and already well under cultivation. In Europe the territory has been mapped out by whole countries, and in the great half-explored regions that have been roughly staked off for one individual it is hard to deny the squatter his little garden patch in soil that otherwise must lie fallow. Especially is this true because the squatter has to pay rent to the landlord just as the rightful tenant would; or, in other words, the manufacturer makes his profit out of the commission man just the same as out of his authorized agent. It is at least a questionable policy which turns down, because it came through an irregular channel, an order that never would have come at all through the regular one.

A further reason why it is well for manufacturers not to make too exclusive agreements with their agents is, that the latter may sometimes fail of receiving orders through their own unpopularity or through the distrust they excite. An Englishman said to an American tool builder: "Your agents are liars—that is, I don't mean yours in particular, but all agents. They will recommend the tool they can make the most profit out of, which is what I call lying." This suggests the additional point, that where an agent represents several competing tool builders they cannot expect him to do his best for each of them, and need hardly bind themselves to greater exclusiveness of dealings than they expect from him.

Upon the matters above considered we have conversed with a number of persons whom we have recently met, representing both sides of the question. One of them made the remark in passing that it is cheaper to ship tools to Germany, and then reship them to France, than to send them directly to the latter country. This introduces an economical element that might complicate the dealings relative to different foreign agents. Our informant also told us that his company is careful to remove from all tools of other makers sold by it any name plate or mark of designation, even if the letters have to be chipped off with a cold chisel. Otherwise the buyer is apt to try to duplicate the tool through some regular commission house.

The president of a New England tool building company recently told us an anecdote regarding a case in which his concern acted in the capacity of middleman. "A number of years ago," said he, "we received an order from San Francisco for a special machine. We applied to certain parties to furnish it. They asked us: 'What are you going to do with it?' We answered: 'That is our business.' 'We have agents,' said they, 'in Germany, France, Sweden, South Africa, South America, etc. Are you going to send it to any of those places?' 'No,' we rejoined. They had also an agent in San Francisco, but that was just the one place they forgot to tell us about. So they furnished us the tool and we shipped it. They heard about it afterward and complained to us. We said 'We thought we were doing you a favor to buy it.' 'No,' they replied; 'we are sorry we sold it to you.' 'We are sorry, too,' we retorted. 'It never will happen again.'"

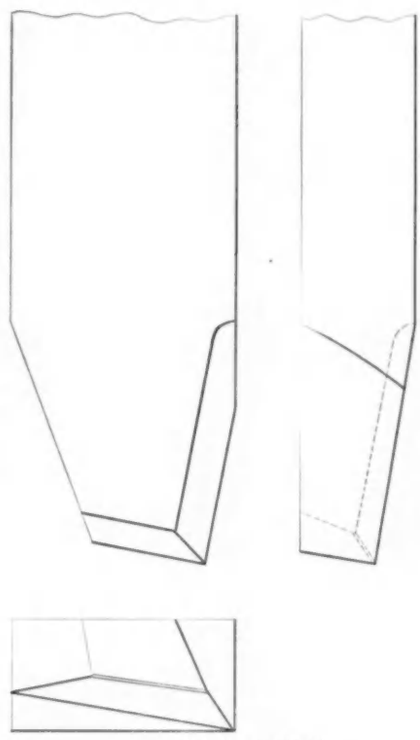
It would be impossible to establish a rule in regard to this question that would meet all cases or satisfy all parties interested. But as fair and equitable a plan as any would seem to be this: that while manufacturers should live up to any formal or tacit agreements they have made with their agents, they should avoid placing themselves in such a position as not to be able under any circumstances to sell a tool destined for the territory of the latter through another intermediary, especially in case the order was one that the agent himself was not in quest of, and probably would have been unable to secure in any event. But when a regular agent has been seeking a specific order, and especially when it is clear that in the absence of competition he could have obtained it, he should of course have the preference. This course will, we believe, commend itself to most manufacturers, and indeed it appears to be the one followed by a great majority of them.

Letters from Practical Men.

A Roughing Tool for the Planer.

Editor American Machinist:

Inclosed sketch shows a planer roughing tool which is new to me, though it may be an old shape. Mr. John A. Graham, a machinist in the shop of the Shaw Electric Crane Company, is the sponsor for it, and says it is the result of a series of trials to get something that would hold an edge and stand up to a cut as long as possible. The tool enters the metal easily without jar or shock. The drawing was made from a tool that had removed from a quarter to three-eighths of an inch of metal from an area of 460 square inches of open-hearth cast steel, and was still sharp. The cutting speed was 16 feet per minute; the feed was about 16 to the inch.



A ROUGHING TOOL FOR THE PLANER.

A. D. WILLIAMS.

Muskegon, Mich.

[This tool will doubtless look to many of our readers as anything but new. The experimenting narrated must have been principally in determining the best angles to use for the specific purpose. The tool is easily made and gives the best means for absorbing the heat developed at the cutting edge and keeping it comparatively cool, so that it naturally should keep its sharpness well. When grinding did become necessary, the surfaces to be ground would be large.—ED.]

Straddle Tools.—Turning Gear Blanks.

Editor American Machinist.

The double facing tool described by "G. D. C." in your issue of March 3 does not appear to be a cheaper method for finishing the sides of blanks than the one to which he referred. The clearance necessary for a "straddle tool" of this kind always tends to increase the width of the work, especially where there is much stock to be removed. It cannot be advantageously used on cast iron work where smooth surfaces are required, unless the scale is first removed, leaving a small amount only for finish, and this necessitates an additional operation. In withdrawing a tool of this kind it invariably leaves a bad scratch on both sides of the work, unless it is fed back slowly to obtain a finish. The straddle tool is a more profitable device for the planer, for planing tongues, etc. In this class of work it can be used to advantage if the scale is first broken and the work roughed almost to size.

But, to return to gear blanks. Untrue work is liable to result from stringing a number of blanks on an arbor between a shoulder and nut, especially when the hole is small, as in change gears. Of course, a turret lathe is the proper place to finish cast iron gear blanks and similar detail, but since we have started this work on the engine lathe, it may be well to submit a few fixtures such as are shown by the accompanying sketches, which will not only do the work quickly, but will do it well.

Fig. 1 shows the gear blank in section, held firmly in a chuck. Holder *A* is planed to fit the slot in the rest, and is bored to fit over the tool-post and securely clamped in position by the short steel bar *B*. The side elevation shows a hub projecting from the under side of the holder *A*, which forms a reasonably long bearing for the pin of the revolving tool block *E*. Tool block *E* is slightly beveled at the lower side and let into holder *A*. Clamped into tool block *E* are tools *C* and *D*, preferably made of self-hardening steel. Tool *C* breaks the scale, and chamfers under the rim and on the end of the hub, as shown by dotted lines. Block *E* is then turned half way around, bringing finishing tool *D* into place.

After finishing the sides the hole is bored with a straight lip cutter held in a holder in tail spindle *F*. Two of these cutters are used; one for roughing the hole within 1-32 inch of size and a second one to insure a true hole. A reamer may then be slipped into the holder and the hole brought to standard size. The keyway should then be cut if the gears are plain blanks.

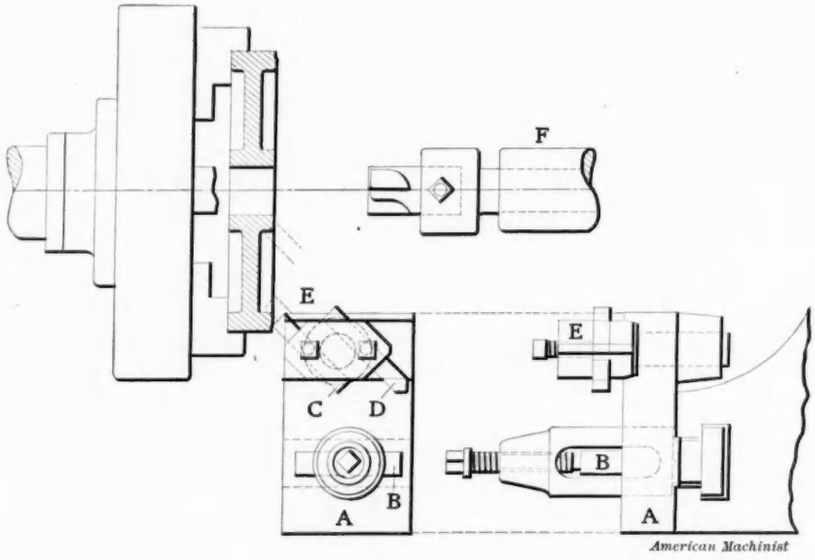


Fig. 1
TURNING FIRST SIDE OF GEAR AND BORING.

Referring to Fig. 2, *J* is a chuck fitted to main spindle *I*. The front face is counterbored to receive a hardened and ground plug *H*, which is provided with a key for driving the small solid blanks. This key may be removed and driver *G* used for armed blanks. The first operation in Fig. 2 is to rough chamfer and finish end of hub to required thickness. This is determined by the amount which plug *H* projects from the face of the chuck. The thimble on the tailstock center is then brought against the blank, holding it firmly in place. The side of rim is then roughed and finished flush with the hub. The periphery of the blank is turned with the same tools, as shown by dotted lines. Disks may be fitted over chuck *J* with their outside diameters made to conform to the work at hand, and one of these may be used as a template for adjusting finishing tool.

W. L. SCHELLENBACH.

New Haven, Conn.

▲ ▲ ▲

Translations of Trade Catalogs.—A Case of Blundering in Russian.

Editor American Machinist:

In one of his letters from Europe last year, Mr. Miller spoke of the importance of having the translation of trade catalogs into foreign languages made, or at least revised, by a person thoroughly familiar with technical terms, and offered some excellent advice on the subject. I would again like to call attention to this matter, as it has just been brought forcibly to mind by seeing a circular in Russian describing the universal and plain milling machines made by an American builder.

The translation has evidently been made by an educated person, as the grammar and the construction of the sentences are beyond reproach, but the

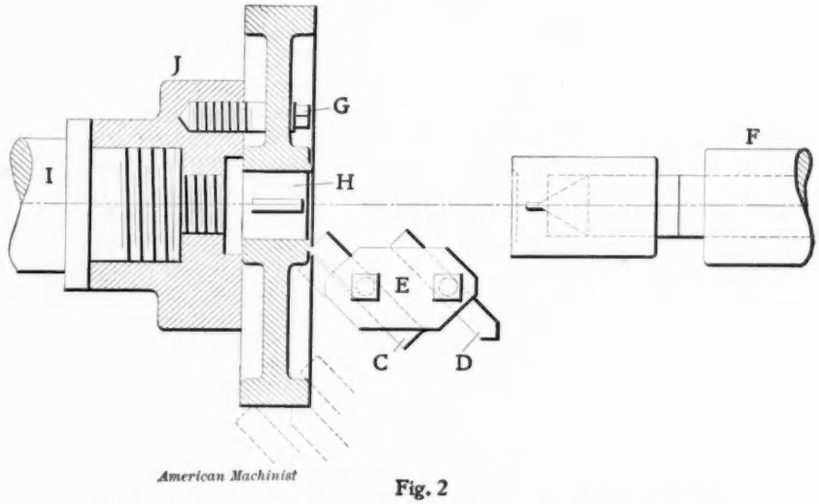


Fig. 2
TURNING THE OUTSIDE AND FINISHING THE OTHER FACE.

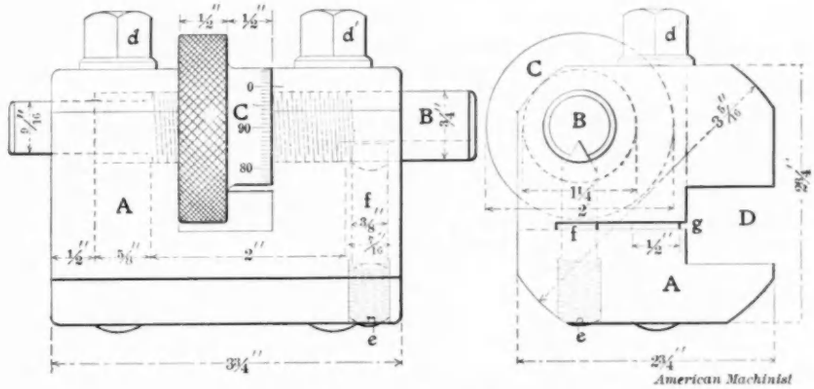
utter worthlessness of the whole thing may be imagined when the English term "milling machine" is made to read in Russian as a "machine for making flour;" a milling machine certainly, but not quite what was intended.

Other blunders of an equally ludicrous character occur throughout the circular, rendering it quite useless for the purpose it was designed to serve.

W. F. DIXON.

Sormovo Works,
Nijni Novgorod, Russia.

▲ ▲ ▲



MICROMETER STOP FOR LATHE CARRIAGE.

Micrometer Lathe-Carriage Stop.

Editor American Machinist:

I send herewith a sketch of a dead stop for lathe carriage which may be of some interest.

The body *A* is made of soft steel (though cast iron would do as well). The saw-cut *g* is to allow a grip on lathe-bed at opening *D*, secured by ½-inch collar screws *d d'*. The screw *B* is made of tool steel, is ¾ inch in diameter, 10 threads per inch U. S. S., ground to fit in body *A*, and has a 60 degree slot running lengthwise forming a seat for pin *f*, which prevents the screw from turning. The travel of screw at left by depth of bore and at the right by a small pin in the 60 degree slot (not shown), which comes against pin *f*, thus preventing the screw from leaving the nut *C*

The hub of the nut *C* is graduated in 100 parts, thus reading to one-thousandth of an inch.

The stop is quickly set, and stays where it is put, and has paid for itself more than once in the year it has been in use in our tool room. It is a tool that will be used more as one becomes familiar with it, and is indispensable after a through acquaintance.

CHARLES W. WRIGHT.

[It is our belief that a very agreeable surprise is in store for a lathesman who is doing good work, is unacquainted with devices of this nature and who makes a good one and tries it. It should be well made, and if so made and intelligently used it will prove useful in very many ways not readily foreseen.—ED.]

▲ ▲ ▲

Hack Saws.

Editor American Machinist:

In your issue of March 3 I note what Mr. L. C. Sharp says about the difficulty of using a hard hack saw by hand. They are not very apt to break if you go about it the right way. If the handle of the hack-saw frame is grasped in the right hand, and this hand placed against the breast and kept there, the entire body can be swayed forward and backward while sawing, with very little danger of breaking the saw blade. By this means a little of the "anvil principle" is imparted to the saw blade, and it seems to get through the work all right. As a secondary consideration, this method of sawing also insures that the stroke shall not be too fast, which, as Mr. Sharp observes, is quite a common error. I use these hard saw blades altogether, but break only a small percentage of them.

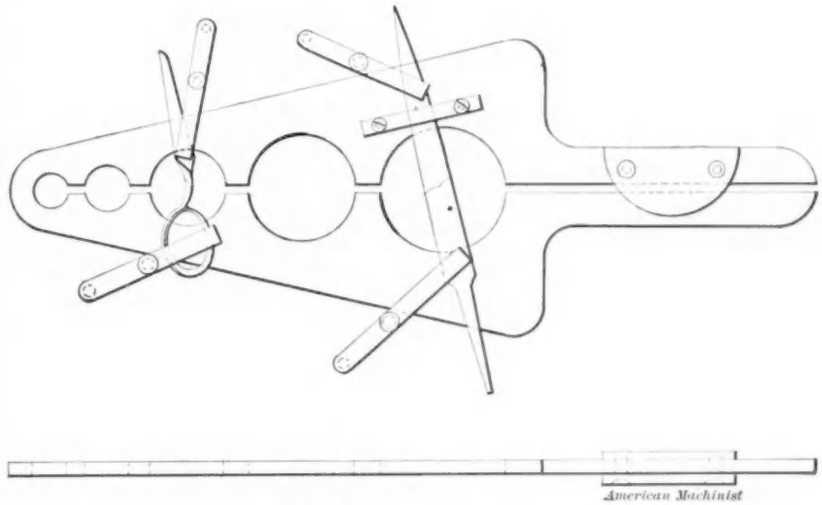
WALTER GRIBBEN.

A Soldering and Brazing Rig.

Editor American Machinist:

The soldering and brazing rig shown in the sketch is a handy tool for jobs that occasionally come up in the machine shop. I have tried many times to braze small articles, like the scissor blade shown, by wiring the parts together, and have then stood with the blade in a pair of tongs and seen the wire stretch in the flame and the pieces fall apart, or open so that all the silver solder or spelter would run out. This rig gets the better of this trouble, and is handy for brazing or soldering any ordinary pieces. The file job shown is an old trick, and a good one, that is none the worse for being held up in sight once in a while. A nice Swiss file will sometimes fall from the bench and break. Somehow it is usually the new one that does this, and you don't want to lose it. Take it up at once; if the fracture gets dirty it will never hold as well. This is one of the jobs that want to be done "right off." Tin each piece carefully and brush off the superfluous solder with a stiff bristle brush, if you have one. Clamp them together on the brazing fixture, see that the joint is good, and warm up over an alcohol lamp or Bunsen burner. The solder will flow before the temper will start in the file. Touch the joint when it does flow with a drop of acid, and a minute drop of solder may be laid on the joint; it will run into a joint however tight. When this has been done brush off the solder from the file teeth and let it cool by dropping water slowly on it, keeping a slight pressure on the handle to insure a close joint. When cool the file will break somewhere else rather than in the joint.

I make the fixture from ¼-inch sheet steel, and it is well to plane up each side, thus getting a straight, flat surface



A SOLDERING AND BRAZING RIG.

to lay the work on. Holes can be drilled at any part of the fixture and tapped out for a strap, as shown on the file, instead of using clamps. MACHINIST.

▲ ▲ ▲

Milling Dovetail Slots.—The Milling Machine for Slotting.

Editor American Machinist:

Your comment upon the shape of the notches and the difficulty of milling them in the nut of the counterbore described in your issue of March 3 surprised me. The notches are indeed "peculiar," inasmuch as they are not of the usual shape. That the wrench will be less likely to slip out seems to be evident, and it is not difficult to mill the notches so as to obtain the desired result, although when milled with the cutters usually found around a milling machine, the corners may not look as neat as they could be made to appear on paper. The accompanying sketches show how I milled some, and also how they might otherwise be done if suitable tools were at hand.

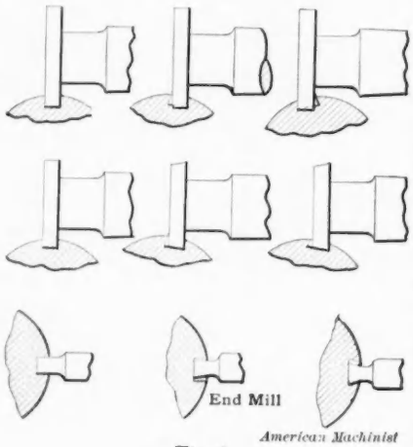


Fig. 1
MILLING DOVETAIL SLOTS.

Fig. 2 shows a good way to shape the ends of the slot for the cutter, and represents the counterbore on centers in a milling machine. *A* is a slotting tool held stationary in the spindle. By moving the slide in and out, imitating the motion of a planer platen, the corners may be squared out nicely, and, if desired, a cut can be taken along the sides of the slot. By turning the counterbore half way around and milling both sides, leaving the knee unchanged, the slot will be made central, and the sides will be nearer straight than they are apt to be made with a mill or a file. The slotting tool can be made with a taper shank and fit into the spindle, or, if a suitable chuck is available, round stock can be used to advantage.

This method is not new or original with me, but probably some of your readers have never happened to see or think of this use for the milling machine.

W. R. G.

The Boys and the Shop.

Editor American Machinist:

I think it a very happy arrangement which permits the correspondents of the "American Machinist" such liberty of speech under the one necessary requirement of always talking to the point. I should like to say a few words (I never talk long) on a matter that I know is and must be of great interest to many in the trade, and outside of it, whether what I say may be of interest or not, and that is about the boys and the shop, and I don't ask the editor or anybody else to agree with me, or to be responsible for a word that I say.

One of the things that I hear very often and in many places, and from those who claim to know all about how to run the world, is, after all, one of the silliest things afloat, and that is that every boy should be taught a trade so that he will have something to fall back on, and so that he will be sure of a living anyway. It is absurd from the simple fact that nobody ever does fall back, say in middle life, to a trade "learned" in his youth, and which he has kept far from him in the interim. Such men, when they have to fall back on something, go into the life insurance business.

Say that a superintendent lets it be known that he has an opening for a machinist—not a tool maker or a high-priced expert, but just an ordinary every-day all-round machinist. A fellow comes along looking for a job. He hasn't worked at the trade for twenty years, but he "served his time," or worked in the shop three or four years away back in the seventies. There is not a superintendent or a foreman fit to hold his position who would be likely to think for a moment of hiring such a man, except some other influence was brought to bear. The man in such a case simply has not a trade to fall back on, and there is ordinarily no place for such as he to fall back into. The trade does not stand still—no trade of to-day is the trade of twenty years ago. So, too, skill or knowledge acquired in the line of any trade cannot be laid on a shelf and picked up ready again for use after twenty years of dust and rust have accumulated upon it.

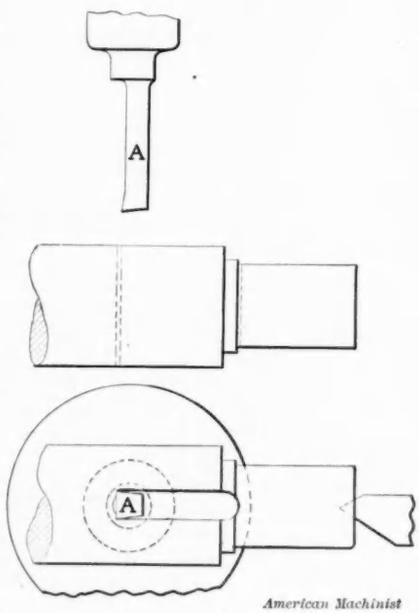


Fig. 2
SLOTTING WITH THE MILLING MACHINE.

The theory of a trade to fall back on is no better when looked at from the other end—the shop end—of it. The youths who want to go into the shop, or who are urged to go into the shop simply to learn the trade, with no expectation of continuously following it, are not wanted in the shop and are of no value to it. The parents or others who try to shove such boys into the shop have not the interest of the shop at heart, or do not design to promote the progress and development of trade methods. It would be more in accord with their theory if the trade could stand still evermore. If these boys do not find ready admission into the shop which means business, and if there is a lot of whining that boys don't get a chance in the world, it is much better for the shops to let the whining go on than to let the boys—such boys—into them.

The life problem and the shop problem should not be confounded. I know, surely, what a task it is to find places for the boys, and what a time of anxiety and disappointment there is before all are fitted into their life positions, and I know how many round plugs are in square holes after all.

Whatever may be said to the contrary, I believe that the machine shops and allied industrial establishments are doing their full share, or are taking all the boys they have use for, and, if that is so, how can their duty extend beyond that? If there are shops that have difficulty in getting boys, and good boys, and all the boys they want, I am sorry for those shops, and I believe that the trouble is with the shops and not with the boys. It is a rather curious fact that about the boys and the shops complaints may be found without looking very far which are absolutely contradictory of each other. There is on the one hand a complaint quite extensively circulated that boys can't get a chance to learn a trade, and on the other hand there are some shops that have to complain that their offers of apprenticeship are not availed of to the extent that they would wish.

To account for this there may possibly be in shop managements, as well as outside, two very different theories and two different practices as to the boys. The shop which is what I call a thorough business shop may start its boys from the first on a business basis. It may take boys because it has use for them and upon the assumption—nothing may be

said on the point—that the boys are to work and are to develop and are to follow the trade right along. Boys taken in this way may be made profitable at once, they may be paid almost living wages from the first, and their pay may be increased quite rapidly. Such shops have no difficulty in getting all the boys they want, and there are some such shops, from which I have personally heard, where the young fellows who have been with them three or four years are regarded as the best paying members of their entire force. This is business pure and simple. The shop and the boys are mutually benefited, without a trace of conscious beneficence on the one side or of unrequited obligation on the other.

Then there are shops which are disposed to greatly magnify the value of the trade in itself, and which consider the imparting of it something for which they should be paid. It is such a privilege to get into one of these establishments that surely those who are so lucky as to get in cannot expect also to be paid for their services, or, at the beginning, not very much. Now, it happens after all, especially in the large cities, that what a boy can begin to earn as soon as he leaves school cuts quite a figure. There are many opportunities for smart boys to earn money from the first. To say nothing of the more menial occupations, such as shining shoes and selling "yellow" papers, there is a great demand for messenger boys, errand boys and office boys for routine clerical work, with numerous chances of advancement. So far as the boy personally has a say in the matter he usually goes for immediate results. He means business, and the business shop has the first choice of him. If the shop which claims to be also a beneficent educational institution is given the cold shoulder, why such is life, and the supply of machinists and other workers keeps well up to the demand whether or no. TECUMSEH SWIFT.

▲ ▲ ▲

The Artist Draftsman.

Editor American Machinist:

I was assistant "boss" in the drawing room of a large concern building heavy machinery, such as rolling mills, heavy gears, etc., when our superintendent brought to us a young Swede, whose diploma and record seemed to our aforementioned superintendent to adapt him to our line of business.

We started him with a couple of tracings, so he would have a little chance to get acquainted before we gave him "brain work." I never saw such a sneer on a man's face as was on his when I was deputized to show him what we wanted done. Being a little independent he told us in good English that he was accustomed to "designing," and gave us to understand, with the aid of his red-sealed diploma, that he was perfectly competent to undertake "responsible work."

Our shop was in an out-of-the-way locality, so to humor him we gave him a "designing" job, a roll housing. I kept my eye on him, and after some little conversation drew out these facts—that he was accustomed to working on *clocks*, that a 16 pitch gear was "big" to him, that he could work to 1-64th of an inch. The reader can imagine his adaptability to the work he had in hand.

We told him he would have to trace until he became familiar with our work. He wanted to quit on the spot, but I humored him and with little encouragement induced him to stick. Such tracings as he made I never saw—as regular and clean cut as a steel engraving; his lettering was perfection, and quick! He could turn out twice as much work as the other tracers—old hands. I found the reason for his speed in the fact that a large amount of his work was done freehand because he was "mad." His pay was raised to $4 a day, and his output was still greater and better.

One day he "quit" rather suddenly, and was lost to view, until not long ago I found him in charge of the art work on a large newspaper, drawing a large salary as well as pictures, and possessed of a good reputation for his clearness and "tone" of execution.

It seems, while he was working for us, he discovered his ability to sketch freehand, and soon put it to good use.

Moral—Don't stay in the mechanical business if you are better fitted for something else, and you may find it out through just such a criticism of your abilities. CISNARF.

▲ ▲ ▲

A Ring Bending Job.

Editor American Machinist:

How often in a machine shop we work hard and accomplish little when some easy and quick method lies just at hand? I recall an instance of this kind which happened some years ago in an Eastern shop.

A part of the work in the blacksmith shop was the production of a considerable number of heavy wrought iron rings, the largest size being perhaps 18 inches outside and 8 inches inside diameter, and 1 inch thick. The method was to bend them (edgewise of the stock, of course) and weld. The amount of muscle required to bend and weld one of the larger sizes (by hand) was immense. At one end of the forge shop stood a very powerful old lathe of about 60 inches swing. Long unused and covered with dust it was considered of very little value. One hot day, as Harry the blacksmith stood resting after a round with one of the big rings, he happened to glance at the old lathe, and he thought, "If I could use the strength of those great gears in bending those rings what a service it would be!"

Soon an idea came to him, and after a talk with the boss he went to work on his plan, which was to use the old lathe to wind or bend the rings around a former or hub bolted to the face plate. With a swinging dog or pawl to grasp the end of the blank and draw it in, and a roller on a piece in the tool post for the blank to run over, his rig was ready.

Heating a blank well and placing it in position he started the lathe, and in about the length of time it would have taken old Mike (his helper) to spit on his hands and get ready to strike the ring was bent. One of the hardest things for an honest and ambitious man is to work at a great disadvantage and feel that half of his time is being thrown away. And oftentimes a small outlay of thought and money will work wonders, as in Harry's case. O. L. DOHIP.

▲ ▲ ▲

International Registration of Trade Marks.

In connection with the International Union for the Protection of Industrial Property, which was formed in 1883 through the convention concluded at Paris March 20 of that year, the Union for the International Registration of Trade Marks is of importance. This subordinate union was formed at the conference at Madrid in 1890, and concluded at a later conference. It includes at present nine nations. The purpose of this union is to enable a citizen of one of the members of the union, having registered his trade mark in his own country, to secure registration of that mark in all other countries of the union without the difficulties and delays attendant upon applying separately for registration in each country.

The importance of having trade marks protected—and in many countries registration is necessary to protection—has been forcibly impressed upon American manufacturers, who, sending their goods into some foreign country, have found the very trade mark which has become of value to them registered in that country to some citizen of the country who made application for registration for no other purpose than to enable him to demand of the American manufacturer a price for the right to sell goods marked with that particular trade mark in that particular country. This has frequently happened, especially in Germany. A United States manufacturer, whose trade mark is known from one end of the country to the other, recently complained to the Patent Office that his trade mark had been copied and registered by a German manufacturer, who was able, by virtue of his registration, to stop the American manufactur-

er's trade in Germany. As in a number of European countries registration of a trade mark is attributive of property in such mark, and is granted, not to the first adopter and user of the mark, but to the first applicant for registration, and as in these countries the registrant can, under the laws there in force, forbid the importation of goods marked with the trade mark registered by him, or even compel the seizure of such goods, it is evident that such registrant has the manufacturer who is the rightful owner of the mark completely at his mercy so far as trade in that country is concerned.

It is believed that the international registration of trade marks, which may be effected through this union, would be of material value, and is practically indispensable to those of our manufacturers who desire to develop their foreign trade. In the interest of these manufacturers the United States should become a member of this union.

At the recent conference of the International Union, which was held at Brussels in December of last year, the United States delegates, Hon. Bellamy Storer, Minister to Belgium, and Mr. Francis Forbes, took an active interest in the discussion of changes proposed in the agreement respecting the international registration of trade marks, though the United States is not at present a party to that agreement. The purpose of this agreement is to make the International Bureau at Berne the centre of a cheap registration which shall be efficient over the territory of the adhering states. The fee for this international registration was reduced to 100 francs for the first mark, and 50 francs for each of all other marks for registration at the same time by the same owner.

▲ ▲ ▲

High Range Compressed Air for War Ships.

BY FRANK RICHARDS.

It seems to be a duty, and especially so now that the thoughts of the nation are turned to run in warlike channels, to call attention to the possibilities for a greatly increased economy, with many collateral advantages, that may be secured in the use of compressed air as an auxiliary means of power transmission upon ships of war. The necessity for the employment of some means, other than steam, for such transmission is well appreciated, and the comparative merits of hydraulic, electric and pneumatic transmission have been quite fully discussed and are generally understood. Each system has been separately installed, and each is in more or less satisfactory operation. The United States monitor "Terror" is fully equipped with a compressed air system. All the apparatus employed upon her has been thoroughly tried and found to be reliable and satisfactory in operation. In comparison with the auxiliary power equipment of ships employing other systems the "Terror" has given a good account of herself, although it is well understood that the installation is an experimental one, and conceded that apparatus, operating with the same pressures and on the same general principles, could now be installed, giving much better satisfaction all around.

But I wish here to call attention to a modification of the system which could not fail to be an improvement in many particulars upon the present at its best. When compressed air is employed for power transmission the usual practice is to compress it to the required pressure, and then to use it with only the normal pressure of the atmosphere opposed to it, and to exhaust or discharge it directly into the atmosphere. Compressed air has been and is so used upon the "Terror" and elsewhere. The title of this article suggests or defines the improved and more efficient system. Although in the proposed system the air is used at a considerably higher initial pressure, that fact alone is not all. The pressure of the air in use is not allowed to descend to that of the atmosphere, but is maintained throughout the cycle of operations at a much higher range. Not only the initial pressure of the air is higher, but the terminal pressure also. The air is returned to the compressor under considerable pressure, instead of, as in the usual practice, being exhausted where it is used, and fresh atmospheric air only being compressed to succeed it.

The available or effective working pressure may be the same in either case. Say that under the old and accustomed practice we have been compressing our air to 100 pounds gage and discharging the air after use into the atmosphere. Neglecting friction, we have here an available pressure of 100 pounds. This 100 pounds may not be the pressure best suited to the work which we may have to do, on a ship of war or elsewhere, but it will serve as well as any for illustration. If, now, instead of compressing to 100 pounds, gage, and discharging the air at 0 gage, as we have been doing all around, we compress the air to 200 pounds and discharge it, or rather return it to the compressor, under a pressure of 100 pounds, we have the same difference of initial and terminal pressures as before, and the same available pressure for use, but the conditions affecting the efficiency of the system have changed quite astonishingly. Volume for volume the air working at the high range is worth precisely the same for power purposes as that working at the low range, with the same difference or excess of pressure in either case, but on the other hand the power cost of compression, terminal volume for volume, is only one-half in the one case what it is in the other. Halving the compression cost doubles the ultimate efficiency.

Not only is the power cost of compression cut in two by the high range practice, but other important advantages appear, as cited in my article in these columns on March 24.

The differences of temperature which accompany the compression are so reduced that it is no longer necessary or profitable to employ a two-stage compressor, with cooling apparatus to be traversed by the partially compressed air between the compressing cylinders. We thus not only have one cylinder instead of two, and without the intercoooler, but a cylinder of one-half the diameter, or of one-quarter the cubic capacity, delivers the same working volume of air. This point is of especial importance and value upon a ship of war, where it is necessary to economize space to the utmost and to secure simplicity of mechanism and ready accessibility for repairs.

The using of the same air continuously, and its consequent drainage of moisture, removes the most persistent traditional objection to the use of compressed air. The possible "freezing up" of compressed air in use has figured in connection with it from the first, and has persistently clung to it. In the proposed system it is doubly impossible for any freezing up to occur, because there can be little or no moisture left in the air to be frozen, and because in the use of the air at no stage is a sufficiently low temperature attained.

As an offset to all the indisputable advantage of the high range compressed air system there is to be urged on the other side the single fact of the return piping required. The distances to be traversed on a ship are so small that neither the cost of the piping, the friction of the return flow nor the possible slight increase of leakage cut any appreciable figure. With an always present supply of steam for operating the compressor, its action in the maintenance of the required pressure may be made absolutely automatic up to the limit of its capacity. The apparatus to be employed should all be designed and constructed in view of the changed conditions of the new system, and no attempt should be made to apply it to existing apparatus. The system would seem to be deserving of the serious consideration of those who have to do with the design and construction of the modern navy.

▲ ▲ ▲

Locomotives for the East.

The steamer "Fallodon Hall," which sailed from this port on the 16th inst., carried 27 locomotives and 1,500 tons of steel rails for China and Japan. The locomotives are from the Pittsburg Locomotive Works.

Foreign News Notes.

There is reported to be a good opportunity for the introduction of hardware and tools, self-feeder heating stoves, fireproof safes, agricultural machinery and implements, also typewriters, in Bohemia, provided an agent was established there who could show the different lines of goods by samples. Advertisements and catalogs will do no good; but investigation among the merchants shows that if such a plan were adopted there would be no question about the building up of a good trade. It is not suggested that it would be necessary to have a separate agent for each article or line of articles, but a number of dealers could combine together and establish such an agency, sharing between them the necessary expense.

In the majority of instances we enjoy the monopoly of trade in British Honduras, but in the matter of hardware, cutlery, shot and ammunition and gun-powder there is room for a little hustling.

The price of steel rail for the present year in Russia is to be $34.72 per ton, instead of $50.84 per ton, which has been the ruling price for the past five years. The Government railways have offered the first-mentioned price, and have stated that if it is not accepted they will buy abroad; so the syndicate of rolling mills had to accept that price. The object of the Government's making this reduction in price was to prevent all the rolling mills that were making bar and other kinds of iron for the market from reconstructing their rolling mills for manufacturing rails exclusively, as the manufacture of rails is said to have been so profitable that the rolling mills have made dividends of as high as from 60 to 70 per cent. A. F. TENNILLE.

▲ ▲ ▲

Technical Publications.

THE CALORIFIC POWER OF FUELS. By Herman Poole. 279 6x9 inch pages, with 40 illustrations. Wiley & Sons. Price, $3.

This book is a very complete treatise on its subject and will be found of decided value by all interested in the testing of fuels. Perhaps its most valuable feature is the very extended table giving the results of tests by various experimenters. This table occupies thirty-nine pages and collects together all the information on this subject that has been published. Simple reference to this table gives the calorific value of most of the coals in use, as well as of coke, peat, petroleum, natural and artificial gas.

THE TUTORIAL CHEMISTRY. Part II. Metals. By G. H. Bailey and Wm. Briggs. 300 4¼x6¼ inch pages, with 93 illustrations. Hinds & Noble. Price, $1.

This book is a continuation of the volume which we noticed about a year ago. Of elementary chemistry there is probably no better text book extant. Unusual attention is given to chemical physics, of which subject such topics are introduced as are essential to a due appreciation of the modern science of chemistry. The order in which the elements are taken up is that suggested by the periodic system in order to bring out the relationships which exist between the members of the same family, and to represent the chemical elements in a continuous series.

LUBRICANTS, OILS AND GREASES. By Iltyd I. Redwood. 54 5½x8¼ inch pages, with three folding plates. Spon & Chamberlain. Price, $1.50.

This is one of the most useful books on lubrication that we have seen. It is not so highly scientific as to be beyond the capacity of ordinary men to read, and it disposes of many crude ideas about tests for lubricants that are current. We are glad to see that it puts a high estimate on the value of the modern greases as lubricants, wherein it agrees with our own experience and observations. At the same time, it classifies greases and points out the kinds to be avoided.

BIBLIOGRAPHICAL DECIMAL CLASSIFICATION AS APPLIED TO RAILWAY SCIENCE. By L. Weissenbruch, secretary of the International Commission of the Railway Congress. 61 7x9½ inch pages. The Bibliographical International Institute, Brussels.

This pamphlet gives a general discussion of the Dewey decimal system of classification, together with its application to the special subject of railroad literature. Examples are also given of the classification of individual books and magazine articles. An interior view of the filing cases in the office of the Internotional Bibliography in Brussels is included, and shows the extent to which the classification of reference literature has been carried at that institution.

MODEL ENGINES AND SMALL BOATS. By N. M. Hopkins; 74 5½x7½ inch pages with fifty illustrations. Van Nostrand & Co. Price $1.25.

This book is intended for the use of amateurs, whose first ambition is usually to make a steam engine and the next to make a small boat. Its methods are adapted to the class for which it is intended, the construction of model oscillating and slide valve engines being shown in minute detail, and of a construction capable of being carried out by those of limited resources in the way of tools. The construction of boilers for the engines and boats' hulls is treated in the same way. Beginners in the class of work indicated will find many useful hints in the book.

"The Mechanical Engineer" is the name of the latest addition to our list of foreign contemporaries. It is edited by William H. Fowler, Wh. Sc., Assoc. M. Inst. C. E., M. I. Mech. E., M. Iron & Steel Inst., and published by the Scientific Publishing Company, Manchester, England. The first number is a creditable one in every way—contains matter likely to interest those for whom it is intended; well printed and illustrated.

We have received No. 10 of Prof. J. G. A. Meyer's "Easy Lessons in Mechanical Drawing and Machine Design." The drawings in this number illustrate very copiously the forms of bolts, nuts, washers, etc., and the text gives a liberally illustrated discussion of the principles of descriptive geometry as applied to mechanical drawing.

We have received in pamphlet form the inaugural address delivered by Mr. Henry Webb on the occasion of his taking the office of president of the Manchester Association of Engineers January 15. This address consists almost entirely of information about things seen here in America during a recent tour made by the speaker, and comparisons between corresponding things and methods here and in Great Britain. The address is strongly eulogistic of American methods, and the speaker is evidently very firmly convinced that if British manufacturers in the iron and steel trades are to compete with ours their methods and ideas must be very materially changed. An American who should put the case one-half as strongly would be accused by "The Engineer" of indulging in "Yankee brag and bounce."

▲ ▲ ▲

The new British warship "Powerful" has recently made a trip to China. She had 2,800 tons of coal on board on leaving Portsmouth, England, and took on successively at different points 800, 2,286, 800 and 2,115 tons, or a total of 8,800 tons, costing, it is said, not less than $55,000.

▲ ▲ ▲

The comparative outputs of the world's three greatest producers of pig iron for the year 1897 were: United States, 9,652,680 tons; Great Britain, 8,609,459 tons, and Germany, 6,889,067 tons, or a total of over 25,000,000 tons, and it is estimated that for the present year the production of the United States alone will be close to one-half of this amount.

▲ ▲ ▲

A recently issued patent is for a "Multiple Energizer Momentum Engine." It is not a perpetual motion, but carries a "something for nothing" suggestion.

▲ ▲ ▲

It is announced that all the decorations at the coming exhibition of the Massachusetts Charitable Mechanics' Association will be fireproof.

▲ ▲ ▲

In a manufactory of artificial ice one ton of coal burned produces five tons of ice.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,

256 Broadway, New York.

JOHN A. HILL, President and Treasurer.

C. A. HANSMANN, Sec'y.

Editorial Department.

FRED J. MILLER, Chief.

FRANK RICHARDS, F. A. HALSEY, EDWARD P. BUFFET, } Associate Editors.

Illustration Department.

A. L. DONNELL, Chief.

Advertising Department.

C. P. DAY, Eastern Representative.

J. M. WAKEMAN, Western Representative.

Foreign Agents:

R. E. HOWARD,
10 Finsbury Square, London, E. C.,
Representative for Great Britain.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

WEEKS & JOHNSON,
Lovedoy St., Johannesburg,
Transvaal Republic,
Representative for South Africa.

Space in advertising pages only is for sale.
We invite correspondence on subjects pertaining to machinery.
Name and address must always be given, though not necessarily published.
Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.
Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrappers denotes week with which subscription expires.

Subscription Price:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1897.

▲ ▲ ▲

Mathematical Analysis as Applied to Machine Construction.

We have several times expressed the conviction that analytical methods of determining the proportions of parts of machinery, unless fortified by reference to practice for the determination of constants and coefficients, give results which are well nigh valueless. The subject is again brought to our attention by an article on the "Weight of Fly-Wheel Rims for Air Compressors," which appears in a recent number of "The Mechanical Engineer," of Manchester, England. The author applies the recognized principles of fly-wheel design for steam engines to air compressors, assuming a coefficient of fluctuation to suit preconceived ideas, and then determines the weight of rim of a wheel suitable for a compressor having 10x20 air and steam cylinders running at a speed of 100 revolutions per minute.

A leading compressor in the American market, and one which has been repeated many hundreds of times, is an 18x30 Corliss frame machine, fitted sometimes with Corliss and sometimes with Meyer steam valves. Its rated speed is less than that assumed by the author of the article under discussion, but while this would strengthen the force of the remarks to follow, it is, in order to simplify the comparison, ignored. The machine has steam and air cylinders in line and is made both duplex and half duplex, but the latter construction being the worst for the comparison is the one here considered. In the article referred to, the air and steam cylinders are supposed to have separate cranks, the angles of which are adjusted to one another to give the best possible equalization of effort to resistance, while in the machine here compared with it those angles are about the worst possible for that purpose. On the assumptions above outlined our author determines 8,542 pounds as the correct weight of the rim of the wheel, while the actual machine cited has a wheel weighing—arms and all—12,000 pounds. The cylinder capacity of the actual machine per stroke is 4.8 times that of the hypothetical one on which the calculations are based, and yet the weight of the wheel—neglecting the spokes, which, if deducted, would make the comparison worse yet—is but 1.4 times as great. In other words, capacity for capacity, its fly-wheel weight is but 29 per cent. of what this article would call for, and this without considering the effect of the arms or the arrangement of the cranks, which, if included in the comparison, would largely reduce even this figure. And it should be said that the wheel here compared with the calculations is amply sufficient; in fact, represents heavy practice.

The comparison is sufficient to entirely discredit the calculations, and a moment's reflection is sufficient to show that the result is due to the assumption by the author of a coefficient of fluctuation to suit preconceived ideas, instead of determining that constant or some other constant to take its place by reference to actual and successful machines. The fact is that the coefficient of fluctuation, as such, is of no possible importance in connection with air-compressor work, and while its determination from actual compressors might assist in proportioning wheels for other machines, no one cares what the actual fluctuation in passing the centers is, so long as the machine does not stop.

Air compressors work under wide variations of speed to suit the fluctuating demand for air, and as this demand is likely at times to be very small, it is essential that compressors should be able to run at very slow speed without catching on the centers, and it is for this reason and for no other that a heavy wheel is better than a light one. If a compressor must be kept running at good speed in order to avoid stopping, then under conditions of light demand, more air will be made than will be needed, and the surplus will go to waste through the safety valve. This is all there is of the fly-wheel problem as related to air compression, and in order to show the sufficiency of the wheel here cited, the writer would state that he has frequently seen its machine—in the half duplex form—run against full air pressure at 8 and 10 turns per minute.

The entire circumstance grows out of the assumption that mathematical analysis, with assumed values for constants, is capable of giving reliable results. In the present temper of many writers it cannot be too often asserted that the only proper office of mathematical analysis in such work is to give the law connecting different cases, whereby constants derived from practice may be made to serve as guides in other cases. The attempt to obtain constants by assuming what they ought to be has brought much undeserved credit on analytical methods. Such a plan is to the last degree unscientific, though masked under a cloak which gives it the appearance of being ultra-scientific. The plan is, in fact, simple guesswork, thinly disguised. If the constants forming the base of calculations for fly-wheels are to be guessed at, we might just as well guess at the weight of the wheel outright, and save the labor of the intermediate calculations. In either case it is guesswork in the end, and the results are just as apt to be correct in one case as in the other.

It was for this reason that we set such a high value on Professor Barr's paper on engine proportions, read before the last meeing of the American Society of Mechanical Engineers. That paper was an application of the method here advocated. We have had in the past many averages of formulas published, but Professor Barr averaged practice, and thus obtained constants which when substituted in rational formulas give guides for practice which can be depended upon. If other writers would follow the same methods we would hear less derision of "theory" and the value of analytical methods would be given a proper rating. The time has gone by for the old line of mathematical work to be received with respect, and the sooner it is abandoned the sooner will analysis be accepted as a useful method.

▲ ▲ ▲

Translations of Trade Catalogs.

It would perhaps appear rather ungracious in us to say that the builder of milling machines referred to by Mr. Dixon in his letter printed elsewhere in this issue deserved to be laughed at by prospective Russian customers for presenting to them a circular illustrating

milling machines and talking of flour-mill machinery. But, regardless of our opinion as to the justice of the penalty, this will certainly be the uniform and inevitable result of ignoring the advice of those who have made a study of these matters, and it would seem to be clear to anyone stopping to think for a moment about the matter that such blunders as Mr. Dixon describes must be a certain result of having translations made by persons not acquainted with technical terms, no matter how well educated they may be.

This is a matter which *must be* given attention by those who would do business in foreign countries, and the wisest machinery builders will be those who at once see the importance of it without waiting to receive the expensive and vexatious practical lessons that are taught by experience in going wrong.

▲ ▲ ▲

We publish elsewhere in this issue something regarding the international registration of trade marks which ought, we think, to receive attention. There have been many instances of what is far worse than mere copying of designs by foreign manufacturers, *i. e.*, copying of trade marks, names of American manufacturers, etc., and placing them upon goods—machinery, etc.—of far inferior quality. The adoption of a trade mark and its registration abroad might help in the detection of such frauds.

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(30) J. & N. C., Portland, Me., says: (1) I am unable to obtain consistent results from the formula and diagram for centrifugal force published in the issue of February 17. The case is one of a 14-foot fly-wheel, weighing 28,000 pounds and running 75 revolutions per minute. Using a constant .1 from the diagram I obtain 470,400 pounds for the total centrifugal force, while the formula gives 365,703. A.—To obtain closely accurate results at slow speed you should follow Mr. Hopkins' third paragraph. Doing this you will find the constant to be .0707 and $.0707 \times 164 \times 28000 = 365982$, which is very closely the figure obtained by calculation. (2) A locomotive has expansive tires and telescopic spokes; could the centrifugal force of the tires lift the engine from the rails? A.—No. The telescopic spokes would prevent the transmission of any force from the upper part of the rim to the wheel center, and the centrifugal force of the lower part of the rim would be resisted by the rail. (3) What rule for safety valves is better than the old ones based on grate area, and what is the comparison between lever and pop valves? A.—The whole safety-valve question is in a state of chaos. Most official rules still base the area of the valve on the grate area, though the Philadelphia rule applies directly to natural draft only, and in the cases of forced draft the area of grate is to be estimated at the rate of 1 square foot of grate to each 16 pounds of fuel burned per hour. The rules of the United States supervising inspectors of steam vessels assume that a pop valve will discharge one-half more steam than a lever valve of the same diameter. (4) What is the formula for the efficiency of triple and quadruple riveted butt strap boiler seams? A.—The following are the Philadelphia rules for the strength of boiler seams, which are probably the best of any that have been made into law: Formula A: From the pitch of the rivets subtract the diameter of the holes and divide the remainder by the pitch of the rivets. The result is the percentage of strength of the net section of the sheet at the seam as compared with the solid part of the same sheet. Formula B: The continued product of the area of the hole, the number of rows of rivets in the seam, and the shearing strength of the rivet per square inch of section, divided by the continued product of the pitch of the rivets, the thickness of the sheet, and the tensile strength of the sheet per square inch of section, equals the percentage of the strength of the rivets as compared with the strength of the solid part of the sheet. It is further provided that the shearing strength of iron rivets shall not be considered in excess of 40,000 pounds. The above rules apply to any number of rows of rivets. In computing the actual strength of a boiler the lowest value of the percentage found by (A) or (B) is taken.

(31) A. H. G., Sanger, Tex., writes: A and B have an argument about the lift of a pump. A has charge of a Deane steam pump. The water supply is from a creek. The ordinary lift of pump is 25 feet. When creek gets very low the lift is 29 feet, perpendicular. At this lift the pump must be run quite slowly. If run at the same speed when lift is only 25 feet the pump loses water and jumps. A claims if a weak spring, just sufficiently strong so as to close the suction valves promptly, be put on the suction valves the pump will work better at the 29-foot lift than if stronger springs were used. B says it will not. Is A right or wrong, and why? A.—We referred this question to the makers of the pump mentioned, who reply as follows: The functions of the springs on the water valves of a pump are twofold, one to keep the valves from opening too far and so cause an unnecessary loss from slip when they close, and, second, to cause the valves to close promptly when the current of fluid ceases to flow through them as the pump reverses. The proper tension of the springs depends upon the velocity with which the fluid flows through the valves. The adjustment of this tension is more important on suction valves than on discharge valves, as the proper filling of the pump cylinder depends more largely on the action of the suction valves. If the fluid runs to the pump under a head or if the velocity of the fluid through the valves is high, more tension is required to keep the valves in proper position and to close them promptly than if the supply has to be lifted by suction or the velocity is low; for in the former case the springs have to overcome the conditions, while in the latter case the conditions assist the action of the springs. On very high suctions like that of 29 feet, nearly the total suction power of the pump is required to simply raise the fluid so that heavy springs cannot be compressed nor a high velocity maintained through the valves. Under these conditions it will be readily seen that of the force available to compress the springs and to maintain the velocity of the flow, as much as possible should be utilized for the latter purpose, as the capacity of the pump depends upon the quantity of fluid that can be drawn through the suction valves. To this end the springs should be as light as will permit them to properly perform their function under the described circumstances. If the springs in the pump referred to are of the standard tension A is undoubtedly correct, for force is wasted in compressing these springs, which could with greater advantage be utilized in maintaining a higher velocity of the fluid through the valves and so increasing the capacity of the pump.

(32) H. C. D., Blissfield, Mich., has a 3x4 inch throttling engine driving some iron-working machinery. The engine runs at 300 revolutions, and he desires to know (1) if a 5x6 inch automatic engine, running at 50 revolutions, would drive the machinery. A.—The 5x6 engine would have about 70 per cent. of the power of the 3x4 at the same mean effective pressure. If the present engine is fully loaded the one proposed would not drive, but if the present one is lightly loaded the proposed one would do the work. To decide the question indicator cards should be taken from the present engine. (2) How much more steam would it take to drive a 5x7½ inch automatic engine and do the same work than at present? A.—It is impossible to answer this question without fuller data. The automatic engine might and probably would consume less steam than is now used. (3) I inclose a sample deposit which accumulates in the base of my steam whistle and in the pipe leading to it. The pipe has to be taken down and cleaned nearly every week. No other boiler here has this trouble, though they are all supplied with the same water that I use. Can you tell me what it is? A.—We submitted your sample to the Hartford Steam Boiler Inspection & Insurance Company, who have had their chemist analyze it. He reports as follows: "On analysis I find that it consists almost entirely of zinc oxide and particles of metallic zinc, ordinary scale matter associated with it in too small an amount to be of any moment. This substance is of the same character and quality as would come from pig or plate zinc hung in boilers or heaters. Did it come from galvanized piping I would expect iron with it, or from brass fittings copper and lead, which are not present in notable amount. Knowing what it is, the cause and prevention can probably be suggested by someone familiar with all the circumstances."

(33) J. H. W., Augusta, Ga., writes: Inclosed please find sketch of an engine drive; pulley is 36-inch double leather, and slips before we can get full load on the engine. If we put on a three-ply belt and an additional idler or tightener, as shown, will it help matters, and how much power ought a three-ply belt to transmit if arranged as shown by red lines? A.—The sketch inclosed by our correspondent shows a tightener applied to the upper and driving side of the belt, and he proposes to raise this tightener and to put in another one below and on the slack side of the belt, thus bringing the two sides of the belt close together and increasing somewhat the arc of contact on the smaller pulley, the increase being probably about 40 degrees of arc. We have not been able to determine very definitely just how much additional transmission may be expected from a triple belt as compared with a double one, but probably it may be expected to drive

about 30 per cent. more. A double belt running under the conditions given might be expected to transmit 350 to 400 horse power, which would give for the triple belt 400 to 520 horse power. In making the change tightener pulleys as large in diameter as possible should be used, as otherwise considerable power will be used in bending the heavy belt over small pulleys.

(34) H. W. K., Haverhill, Mass., asks: How much air does 35 cubic feet of gas require to support combustion? Bunsen burners are used and the gas is from the city mains. What effect does the product of this combustion have upon the air of the room 35x18 feet, 9 feet high, with no special means of ventilation except the cracks around six windows and a 7x9 inch opening in the skylight? These questions relate to a Linotype plant using 35 feet of gas per hour, with probably double that amount at first and until the metal acquires the working temperature. A.—We referred this question to the Mergenthaler Linotype Company, who reply that "the opening specified is manifestly too small for such a room in which men are working and gas is being burned. Our machine contains a hood over the melting pot from which it is customary to extend a small tin or copper pipe to a chimney or other outside opening. If this is done no further trouble will be experienced from heat or fumes, though the fact is that a number of our machines are run without any special provision for ventilation and without trouble." One ordinary gas light equals in vitiating effect about 5½ men.

▲ ▲ ▲

The Mechanical Engineering Department of Columbia University.

As our readers are already aware, a department of mechanical engineering has been recently added to Columbia University, and we recently spent a very enjoyable afternoon with Professor Hutton inspecting the equipment of the new department. The moving of such a plant as that of Columbia University is a heavy undertaking, and in some of the departments the condition of things is still somewhat chaotic. Order is gradually appearing, however, and the equipment already in sight is of impressive magnitude. The buildings which house the university may fairly be called superb, there being in our estimation few architectural effects in this country which equal that of the South Court. The group of institutions now located and to be located on Morningside Heights has caused it to become known as the "American Acropolis," and the library building, with its approach, is certainly worthy of the Acropolis or of any other site. An entire building of six floors, including two well lighted basement floors, is given to the engineering departments, in addition to which is the steam engineering laboratory, a splendid apartment for the purpose, of 32x210 feet, with a clear hight of 21 feet. In this building are housed the mechanical, mining, civil and electrical engineering departments, which are so intimately related and have so much work in common as to make this arrangement highly convenient. Lecture and class rooms, laboratories, museums and drawing rooms fill the building. The drawing room of the mechanical department is the largest, because of the early work of all the departments being done here. It has a capacity for 160 students at one time, and is well equipped and splendidly lighted.

Among the leading features of the steam engineering laboratory is a triple expansion Allis-Corliss engine, fitted as an experimental engine for a great variety of arrangements and including a detachable air compressor cylinder to each steam cylinder for experimental work on air compression, and also for use as a dynamometer for absorbing the power developed by the engine; a set of low, intermediate and high pressure Worthington pumps fitted with triple expansion steam cylinders; a sample of the Dodge rope power transmission fitted to the Allis engine; the experimental locomotive of which our readers have been told; an Ingersoll air compressor, an Otis elevator, and numerous other items of lesser importance. Professor Hutton in fact has been nearly overwhelmed by the extent and liberality of the contributions.

The power plant of the university is itself an object lesson as a piece of engineering on a large scale. In the basement of University Hall Babcock & Wilcox boilers, aggregating 2,000 horsepower, are already in place, while provision has been made for doubling this plant. From this central station steam heat, as well as electric power and light, is distributed to all the buildings. In the various laboratories and workshops a good deal of power is required, which is thus entirely electric. The heating of the buildings is by steam coils and fans located in the several basements, the fans being driven by electric motors. Fans are also placed in the discharge flues, so that the ventilation is positive and independent of weather conditions. The temperature throughout all the buildings is controlled by thermostatic regulators, the fans running continuously to supply ventilation and the steam being turned on or off automatically to maintain a uniform temperature. The fittings of this power plant, like everything connected with the university equipment, is of the highest and most substantial character, the piping, the water supply and the arrangements for handling coal and ashes being noteworthy. There is nothing so calculated to develop enthusiasm in an engineering student as the presence of operative engineering plants other than laboratory equipment, and quite apart from the opportunities for direct instruction offered by this outfit there can be no doubt of its value in this way.

By the recent absorption of the Teachers' College, immediately to the north, into the Columbia University system, the manual training shops of the former have been made available for the students of the latter. These shops include wood and iron working and blacksmith shops and a foundry. Professor Hutton's policy aims at emphasizing the construction or manufacturing side of engineering, and he looks upon the shops as of the highest importance. We even suspect that he looks upon thermodynamics as of less than primary importance, and that while such work will not be slighted, it will not be made the keystone of the arch. Among the tools of the machine shop is a Flat Turret lathe, which was taking off chips that would astonish many an old mechanic. The student operating it did not of course realize what he was doing, but on this point the scheme of instruction contemplates making the same pieces on both the turret and a common lathe in order to emphasize the output of the former. At work on a planer was a student whose lesson was to find out how big a chip the machine could carry. The laboratories, we judge, will be used so far as possible in research work and not in mere weighing and measuring. Professor Hutton recognizes that the engineer is primarily a constructor, that a knowledge of advanced methods of construction and manufacturing is of the highest importance, and that, together with design, construction comprises the greater part of an engineer's work, both in amount and in importance.

▲ ▲ ▲

Meeting of American Foundrymen's Association.

The American Foundrymen's Association will hold its third convention in Cincinnati, Ohio, June 7, 8, 9 and 10.

Committees have been appointed from among local foundrymen and dealers in foundry supplies, who are busily at work completing all the arrangements, and it is expected that this will be by far the most successful meeting in the history of the organization. Reduced rates of fare have been applied for upon all the railroads leading to Cincinnati, and it is expected they will be very generally granted as before from all parts of the country. The list of papers to be read before this gathering has not yet been completed, but will be announced later.

▲ ▲ ▲

"I wont say what a lograthun is, 'cas I don't know, but I reckon, thar's cities been built an' nations riz and fell that never had a darned lograthun to divide among 'em; so they don't seem, as you might say, absolutely essenshul to human progress."—Indian Engineering.

Personals.

Messrs. Millard B. Kitt and E. B. Kittle, who for a long time have been connected with the Sprague Electric Elevator Company, will take charge of the company's branch office in the Marquette Building, Chicago.

Kindly oblige us by sending in personal items regarding changes of foremen, superintendents and others prominently connected with the machine business.

Owing to the death of Mr. James Barrett, the firm of Barrett Bros., machinists, of Boston, has been dissolved and his son, Mr. Alfred L. Barrett, who for some years was with the firm, has associated himself with the National Sewing Machine Company, 126 Pearl street, Boston, Mass.

▲ ▲ ▲

Inquiries for Machinery.

Those who make, or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiries as follows:

46—From Germany, for steel of about .02 per cent. carbon, free from phosphorous and sulphur, and suitable for the manufacture of balls.

47—For makers of crushers of sand rock used in the manufacture of glass. Also sand mixers.

48—For makers of pulley molding machines.

49—From France, for a machine capable of bending cold, copper tubes from 1 inch to 7 inches diameter, without first filling them with sand.

▲ ▲ ▲

Commercial Review.

NEW YORK, Saturday Evening, March 26, 1898.

MACHINISTS' SUPPLIES.

It is an occasion for profound complacency that with the country steadily approaching the brink, as not a few sober persons believe, of actual war, commercial markets show so little tendency to demoralization as at present they evince. If our memories are sufficiently good to reach in detail as far back as the Venezuelan message of our last Chief Executive, and to recall the paralyzing blow that it inflicted upon commercial interests, the unabashed self-possession of trade in the present acute crisis cannot but be apparent. One reason for this is that business has now vastly more energy than it had at that time, when it was very dispirited in tone and ready to respond to the slightest pressure upon the brakes. Again, we are now facing a foe insignificant as compared with the power that then confronted us. Furthermore, we have been knocked about by so many war reports in the last few years that we have been turned into india rubber toward them, and none of them can easily hurt us. Finally, the present crisis has long been foreseen and has been adequately discounted in the stock market so that there is no panic among brokers to stampede the ranks of practical business men.

Machinists' and mill supplies are still quite active, and the present month does not bid fair to destroy the reputation of the winter as a very good one in those lines compared with past years. At the same time many, and we judge the majority, of the miscellaneous supply houses in town are not selling quite so much this month as last. Still trade averages good—in some cases improvingly so—and aside from the war question the outlook is bright. To the public events following the "Maine" disaster some hesitancy on the buying side is evidently due, while to naval munition manufacture a few orders are attributable. Yet among nearly a score of supply and power transmitting machinery houses in this city from which we have received reports not one has been struck by a boom in trade owing to war preparation.

Prices have been comparatively steady of late. Pipe, fittings and valves are weaker.

Reports have come from two emery and emery wheel houses. One states that its business has reached a level the highest in point of activity that it has occupied for three years. The other finds trade, although not so active as last month, still good, and 30 per cent. better than at this time last year. Emery wheels have recently been bought from a local agency by the Brooklyn Navy Yard authorities.

A general supply house which is fitting out a good many Klondike expeditions

Continued on page 38.

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 18.

Power hammers, Jenkins & Lingle, Bellefonte, Pa.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Stationary—Rights of two valuable engine patents, both for $1,000 if taken at once; great bargain. Geo. Wolf, 215 Birch Street, Cleveland, Ohio.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Experienced mech. draftsman. Box 145, AM. MACH.

Situation wanted by A1 pattern maker. Address Box 178, AMERICAN MACHINIST.

Situation wanted by a first-class foreman pattern maker. Address Box 176, AMERICAN MACHINIST.

Mach., eng., dsgnr., d'ftsm'n; pumping mach., engs., etc., open for engagement. Box 164, AM. MACHINIST.

Wanted—Position as foreman by practical machinist and tool maker, age 33. Box 172, AM. MACHINIST.

Wanted situation by blacksmith, good forger steel or iron; also wagon work. Box 141, AMERICAN MACHINIST.

Mech. draftsman and superintendent; 15 years' exp. general machinery and buildings. Box 177, AM. MACH.

Position wanted either as mechanical and engineering draftsman, or as representative of some engineering concern. Box 170, AMERICAN MACHINIST.

A shop superintendent of one of the most successful turret lathe builders desires a change; nine years in present position; best ref. Box 174, AM. MACHINIST.

Wanted—A mechanical engineer with improved special machinery to build, would like to correspond with parties in need of a first-class manager. Address Box 149, AMERICAN MACHINIST.

First-class mechanical draftsman and designer, technical graduate, successful in designing gas engines and tool machinery, wants pos. as ast. supt. or take charge of drawing room; highest ref. Ad. Box 181, AM. MACH.

Wanted—Situation as supt. or mgr. mach. works, by mech. engineer; 15 years' exp. on high speed Corliss and marine engs., pumps and general mach'y; up to date on both bus. and mech. methods. Box 179, AM. MACH.

Parties desiring the services of a factory manager are respectfully requested to correspond with the undersigned, who has had extensive experience and is familiar with modern methods of factory management; a practical mechanic, thoroughly posted on the best practice in machine shops, foundries and kindred departments, having held every position along the "line" in various lines of manufacture; salary or a percentage. Address Box 171, AMERICAN MACHINIST.

Help Wanted.

Wanted pattern tender; one used to foundry and patterns; steady position. Address, Box 134, AM. MACH.

Wanted—One or two strictly first-class blacksmiths for heavy work. Apply The Bucyrus Company, South Milwaukee, Wisconsin.

Wanted—By a large electric manufacturing co., man to take charge of arc lamp department. Address Box 173, AMERICAN MACHINIST.

Wanted immediately 10 first-class machinists, both floor and machine hands. Apply, The Bucyrus Company, South Milwaukee, Wisconsin.

Wanted—A first-class mechanical engineer competent as designer and supt. on heavy hoisting, dredging and marine machinery. Address Box 153, AM. MACHINIST.

Applications for draftsmen will be received at this office for one week; only those with at least two years' experience need apply. John Stephenson Co., Ltd., 47 East Twenty-seventh Street, New York.

Mech. eng., 17 years' exp. as mach., draftsman, supt., and manager, A1 bus. and mech. ability, desires association with mod. mach. works, to build line of mach'y already introduced and on market; $20,000 of orders on hand; chance for concern with plant to secure paying bus. Address, with full particulars, Box 180, AM. MACH.

Wanted—A leading draftsman on heavy hoisting hydraulic and general machinery; must have at least 10 years' experience and competent to take charge of work. Address Box 152, AMERICAN MACHINIST.

Wanted—Experienced foremen to take charge of department in machine and forge shops, running all night; applicants must have had experience in modern shop methods and duplicate work. Address American Ordinance Co., P. O. Box 595, Lynn, Mass.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Book, Dies & Die Making, $1. J. L. Lucas, Prov. R. I.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Emery Wheel Dressers; send for sample and price. Manufactured by Geo. H. Calder, Lancaster, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery dealers wanted as agents in New York, Boston and Philadelphia to handle our automatic engines, etc. Clark Bros., Belmont, N. Y.

Wanted complete equipment of machine shop tools, including lathes, planers, drill presses and boring machines. Address F. C. Austin Mfg. Co., Chicago, Ill.

Wanted—By an established business, two first-class mechanics, with from $2,000 to $3,000 each, to form stock company; object, to enlarge business. Address Box 165, AMERICAN MACHINIST.

Continued from page 37.

reports that line of trade as now active, and that the equipment of some five new companies is in prospect.

POWER TRANSMITTING MACHINERY

is reported increasingly active in spite of the war scare. The amount of trade now being received in this line is very flattering. Prices are gradually becoming firmer. While the figures on stock from store are quite steady, yet in estimating upon contracts the concessions are not so great as formerly.

Silk mills are still a feature of the market. The Geo. V. Cresson Company has just contracted to equip one in Scranton, Pa. Another concern finds the period of greatest activity in silk mills to have been a few weeks earlier than this, and although it does not sell directly to consumers it is inclined to believe that iron manufactories are now the best customers. Still another concern speaks of cement and trap rock works as prominent industries in connection with its late business.

The local manager of a leading wood pulley company, which is meeting with excellent results in foreign trade, remarks as follows: "It is now possible to sell goods freely at a good price in Europe. They are willing to pay for a class of wares superior to the cheapest, which is quite different from the condition in America not long ago. It cannot be said that there is a 'demand' for the goods in England. The English are not in the habit of 'demanding' articles made outside of their own country; but if you take the merchandise over there and offer it they will buy."

MISCELLANEOUS.

The newspapers tell of the multitudes of contractors that have besieged the naval offices in Washington in hope of receiving slices from the $50,000,000 appropriation, but, on the other hand, some appear to be coy about the business. We hear of one who was asked by the Government to build some launches. To fill the order he would have had to double his force immediately and run twenty-four hours a day for thirty days, but he refused to do it and, we infer, let the order go elsewhere. He says that sixty days would be his shortest time to complete them in, for he couldn't sit up twenty-four hours a day.

The Davis & Egan Machine Tool Company reports its business as on the increase at home and abroad. It has lately received orders for heavy screw machines and milling machines from Moorgate, England; for various large tools from Fraser & Chalmers, Erith, England, and for a bicycle machinery outfit from Stettin, Germany.

Several concerns report good exports to Spanish America at the present time. Mexico, Venezuela and the Argentine

Miscellaneous Wants—Cont'd.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

Machinist, having full assortment of modern tools, is looking for location to start jobbing shop; will go in partnership with parties knowing a good opening. Box 175, AMERICAN MACHINIST.

If you use Brass, Bronze or Composition Castings write to us for prices; satisfaction guaranteed on all orders undertaken. James J. McKenna & Bro., 424 & 426 East Twenty-third St., New York. Established 1833.

The advertising department of the American Machinist has on hand 20,000 drafsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Press dies made cheaply; send sample for prices. H. Dalgety, 6 Reade Street, New York.

Advertising Novelties Wanted—We will buy patents, manufacture for patentee or on a royalty, good advertising novelties. Address P. O. Box 125, Erie, Pa.

For Sale—A well established motor and dynamo mfg. business; steady trade with some of the best houses in the country; several valuable patents; special labor saving machinery designed and made for our own work; will dispose of machinery and tools, finished and unfinished dynamos, patterns, wire, etc.; building and water-power to be included or not, at option of purchaser; satisfactory reason for selling; cash price, $15,000. Address Dynamo, care of AMERICAN MACHINIST.

Brains and hands do their best work in the field of their experience. The Century Machine Co., 576 West Broadway, New York, employs trained brains and trained hands in the persons of mechanical experts who are competent to solve intricate mechanical problems and make operative models. The designing of automatic and labor saving machinery is in charge of Mr. Oluf Tyberg and assistants. The Century Machine Co. is equipped with most modern tools as well as men. Light machine work, experimental work, model making and manufacturing solicited.

DON'T apply for a PATENT until you've considered my SPECIAL PROPOSITION. It saves money. Sent FREE.
GEO. R. HAMLIN, Patent Attorney,
809 H St., N. W., Washington, D. C.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

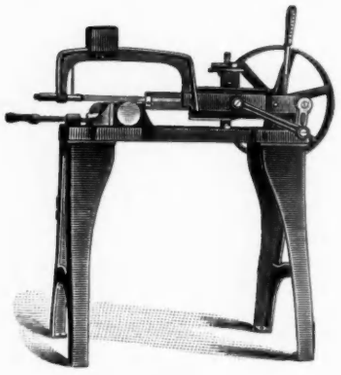
J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE. Secretary and Treasurer.

Use ◆ Diamond Brand
Hardening Compound.
The MetalSpecialty Co., 4 Gold St., NEW YORK

FOR RENT,
In Chicago, heavy brick building, light three sides, 37,500 feet floor, engines, boilers, shafting, elevators, etc., from May 1.
Box 169, American Machinist.

"The best is as good as any."

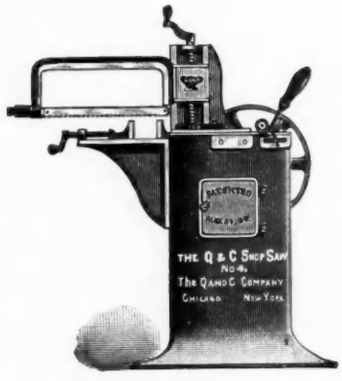
The New
Automatic and Gravity Feed
Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.
Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,
For All Purposes.

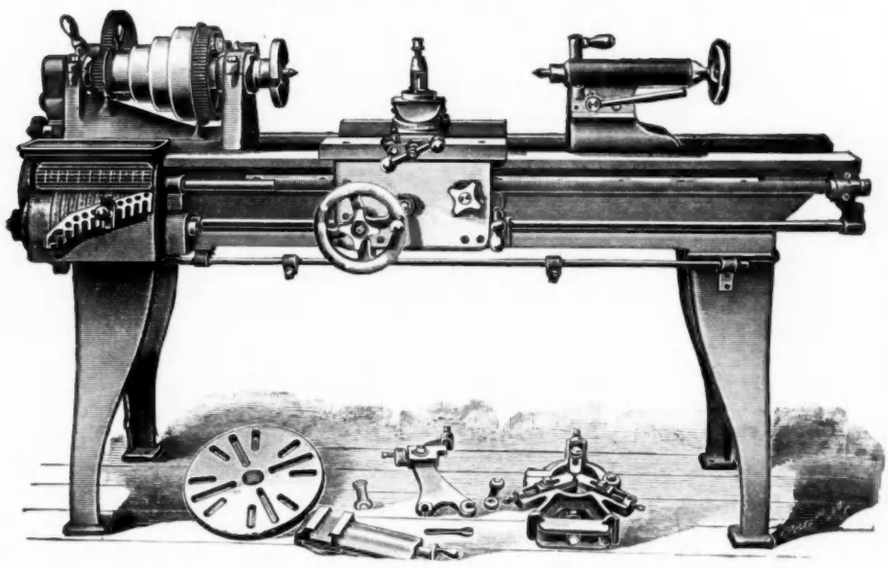


Send for Catalogue.

Q & C Company,
Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

THIS LATHE COMBINES THE LATEST AND BEST IMPROVEMENTS.



14 in. x 6 ft. Hendey-Norton Lathe

With Improved Automatic Stop.

• • •

AUTOMATIC STOP.

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

CARRIAGE.

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

THREADS.

It has all threads in daily use with simple movement of lever.

FEEDS.

Has all feeds in daily use with simple movement of lever.

Send for Circular.

• • •

THE HENDEY MACHINE COMPANY,

Torrington, Conn.

Agents for the Pacific Coast, PACIFIC TOOL AND SUPPLY CO., San Francisco, Cal.

J. W. CREGAR, Philadelphia Bourse Exhibition.

European Agents, { SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm. CHAS. CHURCHILL & CO., Ltd., London and Birmingham, Eng. ADPHE. JANSSENS, Paris, France.

Republic seem to furnish as much of the demand as any countries. J. F. Roges & Co. are about sending two turn-tables adapted to 50-ton locomotives to Central America. They will ship also some other supplies, and another concern whose name is not stated will send 100 iron bridges to replace wooden ones now in use.

▲ ▲ ▲

Quotations.

NEW YORK, Monday, March 28.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	10 00 @ 10 50
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 25 @ 10 50
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock. Common, 1.07½ @ 1.10c.; refined, 1.15 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some grades perhaps a litttle less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.60c.

Cold Rolled Steel Shafting—Base sizes, from store, in retail lots, 2.15 @ 2.20c.

Copper—Carload lots: Lake Superior ingot, 12c.; electrolytic, 11⅝ @ 11¾c.; casting copper, 11¼ @ 11½c.

Pig Lead—Carload lots, 3.70 @ 3.75c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 14.35 @ 14.40c., f. o. b.

Spelter—Carload lots, 4.30 @ 4.35c., New York delivery.

Antimony—Cookson's, 8½c.; Hallett's, 7¾c.

Lard Oil—Prime city, present make, 44 @ 46c., in wholesale lots for a good brand, with a tendency toward easier prices.

▲ ▲ ▲

Manufacturers.

Rinehimer Bros. will erect a new planing mill at Elgin, Ill.

The city of Omaha, Neb., is to install a new water-works system.

At Berkley, Va., the E. H. Barnes Company is making improvements to its plant.

T. G. Brown, of Warren, Ohio, is going to erect a new machine shop at that place.

The West Hoboken Silk Company is to erect a factory at East Rutherford, N. J.

The N. Y., N. H. & H. R. R. is to erect a machine shop at North Adams, Mass.

Thos. Reilly is somewhat interested in the erection of a factory at Middletown, Pa.

An addition is to be made to the Kendall Knitting Company's plant at Ithaca, N. Y.

At Bedford City, Pa., the firm of Kent Bros. are to erect and equip a new woolen mill.

Messrs. Smith & Drum, Philadelphia, Pa., are to erect an addition to their machine shop.

Plans have been completed for an addition to Schuster's Bottling Works, Rochester, Minn.

The machine shops at Jeanesville, Pa., are to have an addition made. This addition will be 50x100 feet.

The Hyde Windlass Company, of Bath, Me., is to make an addition 60x126 feet to their machine shop.

An annex, 400x61 feet, is being built to the chemical works at Ambler, Pa. It will be four stories high.

The Chester Steel Castings Company, of Chester, Pa., is to make extensive enlargements to its plant.

The Richard H. Hall Company, of Detroit, Mich., for the manufacture and sale of brick has been incorporated. The capital stock is $25,000. The shareholders are Richard H. Hall, Dearborn, and

Harriett S. Hall, Petit Cote, Ont.; Kate T. Hawkins, Petit Cote, Ont.; Walter J. Hayes, Detroit; Charles F. Frank, Springwells.

The American Steel Casting Company, of Sharon, Pa., is to make an addition to its plant.

The Montgomery Cooperage Company, Montgomery, Ala., is about to construct an addition to its plant.

The Monarch Novelty Works Company is to remove its plant from Middletown, Pa., to Piqua, Ohio.

Huse-Loomis Ice & Transfer Company, St. Louis, Mo., is to erect a two-story brick ice factory, $10,000.

The American Cotton Company, at Chicago, Ill., is contemplating making extensive additions to its plant.

At Greenville, Tex., a new hardwood factory is to be built, and Mr. W. O. Stamps is interested in the project.

The Renean Iron Works & Manufacturing Company, of Meridian, Miss., has been incorporated. Capital stock, $25,000.

The Centerville Foundry & Machine Company, Centerville, Ia., is going to build a new foundry and machine shop, 220x30 feet.

The Beaver Dam Cotton Mills, of McCall, S. C., have been organized for the purpose of erecting and operating a mill.

Smith, Kline & French are preparing to build a three-story factory, 45x84 feet, on Poplar street, near Beach street, Philadelphia, Pa.

Contracts have been let for the erection of a new flouring and grist mill at Springfield, Tenn., which will be operated by England Bros.

The Sloss Iron & Steel Company has made a contract with the Semet-Solvay Company to construct a bi-product saving plant at Birmingham, Ala.

John M. Buchanan is building a two-story brick spring works, 45x50 feet, at 1439 Hutchinson street, Philadelphia, Pa., for Thomas Insull.

George Arantz Bros., Decatur, Ala., whose mammoth sawmills were totally destroyed by fire recently, are making arrangements to rebuild the plant.

The Glens Falls, Sandy Hill and Fort Edward Electric R. R. Company contemplates the erection of a new power house at Glens Falls, N. Y.

The Peters Cartridge Company, of Cincinnati, Ohio, has placed some rush orders for machinery with the Davis & Egan Machine Tool Company.

The foundry of the Edgar Foundry & Machine Works, located at the southwest corner of Ann and Tennessee streets, Mobile, Ala., was totally destroyed by fire recently.

The William Ferguson Foundry at Chicago, Ill., capital stock $25,000, has been incorporated. Incorporators, William Ferguson, Paul W. Lange, Fred B. Vogel.

At Kittery, Me., the J. H. Long Machine Company has been organized. The officers are: President, Hiram M. Burton, of Boston; treasurer, Everard E. Goff, of Milford, Mass.

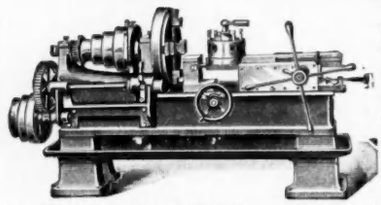
The Hendrie & Bolthoff Manufacturing & Supply Company, of Denver, Col., has been incorporated. Chas. F. Hendrie, Henry Bolthoff and H. P. Waterman are interested.

The Buehne Steel Wool Company, of New York city has been incorporated. F. W. Boehne, of Freeburg, Germany, C. Pily, of 15 Dey street, New York, and P. C. Schnityles are the directors.

The Prentiss Tool & Supply Company is opening an office at No. 504 D. S. Morgan Building, Buffalo, N. Y. It has also just opened one in Cleveland, Ohio, where two of its representatives are located.

At Albany, N. Y., the Howe's Cave Association has been organized and will engage in the manufacture of cement. The officers of the

FACING AND CHUCKING MACHINES.



FOR boring and squaring up hubs of pulleys, and finishing the sides of web gear blanks with one set of tools at one setting of the casting; made in four sizes; all have turret slide support and face plates, respectively 15, 23, 36 and 45 inch diameters.

FLANGE FACING MACHINES for work upon Hydrants, Valves, etc., have two heads adjustable longitudinally, and face plates with slides having positive feed for tools. Will face diameter 30 and 36 inches respectively.

Ask for the Machinsts' Catalogue.

THE PRATT & WHITNEY CO.,
HARTFORD, CONN., U. S. A.

NEW YORK: 123 Liberty Street. BOSTON: 141 Pearl Street. CHICAGO: 42 South Clinton Street.
LONDON, ENGLAND: BUCK & HICKMAN, 280 Whitechapel Road.
PARIS, FRANCE: FENWICK FRERES & Co., 21 Rue Martel.

ENGINE and SPEED LATHES

IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street CINCINNATI, OHIO, U. S. A.
Agents: SELIG, SONNENTHAL & Co., London, Eng.; JOHN TRAGARDH & Co., Göteborg, Sweden; E. SONNENTHAL, JR., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

THE CALORIFIC POWER OF FUELS.

With a very full collection of tables of heats of combustion of fuels, solid, liquid, and gaseous. **By HERMAN POOLE,**

8vo. Cloth. 40 figures, 279 pages. $3.00

JOHN WILEY & SONS, 53 East 10th Street, - New York City.

HIGHEST QUALITY—TAPS, DIES, REAMERS,

Screw Plates, Tap Wrenches, Bolt Cutters, Drilling Machines, Punching Presses, Etc.

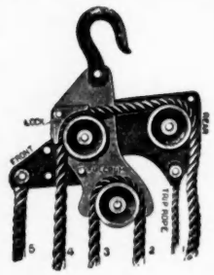
Send for catalogue.

WILEY & RUSSELL MFG. CO., Greenfield, Mass., U. S. A.
Agents in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria St.

WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.

1. Manufactured of the best Steam Metal.
2. No regrinding therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.

JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston.



THE BURR STEEL SAFETY LIFT.

The principle on which it is made is an altogether new departure from anything heretofore devised in this line, the locking being done by the positive action of the load on a lever, the most powerful and unfailing of the elementary mechanical principles. It excels in every particular any similar device on the market, and is the only rope block made that will do the same work as the differential chain block.

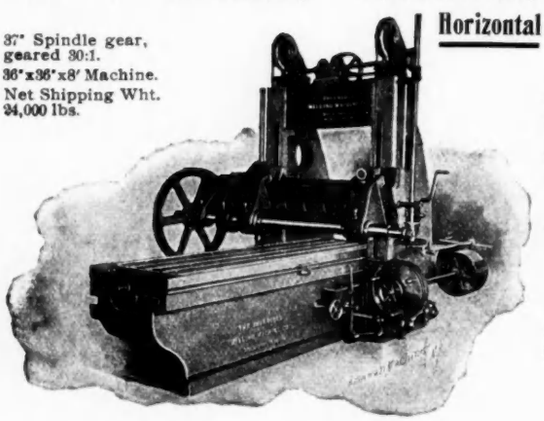
For Electric Work it is the most convenient, most positive wire stretcher on the market.

THE BURR MANUFACTURING COMPANY,
823 Society for Savings Building,
CLEVELAND, OHIO, U. S. A.

HEAVY MILLING MACHINES EXCLUSIVELY.

Horizontal or Vertical Spindles or Both.

37" Spindle gear, geared 30:1.
36"x36"x8' Machine.
Net Shipping Wht. 24,000 lbs.



SIZES:
15", 20", 24", 36", 48", 60", any length.

Wide range of cutter speeds.
Variable table feed from 3-16" to 10" per minute.
Power elevating and lowering device.
Table adjusted by power in either direction.

Write for full information and prices to

The Ingersoll Milling Machine Co.
P. O. Box 2777,
ROCKFORD, ILL., U. S. A.

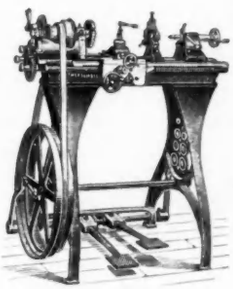
FOREIGN AGENTS:
C. W. Burton, Griffiths & Co., London, Eng.
A. Janssens, Paris, France.
DeFries & Co., Berlin and Dusseldorf.

EASTERN BRANCH,
126 Liberty Street, New York.

Cable Address: "Ingersoll," Rockford.

ACTIVE, RELIABLE FIRM in GERMANY, highly reputed, whose Principal is about to visit the U. S., wishes to enter into **BUSINESS RELATIONS with INVENTORS or MANUFACTURERS of MODERN METAL-WORKING and SPECIAL MACHINERY.** New labor-saving working methods, or new articles of real merit.

Exploitation for joint or own account or representation. **FIRST-CLASS EUROPEAN CONNECTIONS,** wide experience. Great success with sale of patents can be proved. Highest references given and requested. Address "Be Quick," Office of the AMERICAN MACHINIST.



While the Price

10 inch x 25 inch.

of this screw-cutting lathe is little, the quality is great; there are not many lathe being made better. This lathe has many new features, all of which are described in the little book.

Peter A. Frasse & Co.,
95 Fulton St., New York.

For Advertisement of
TIGHT JOINT CO., New York.
See Issue March 3, 1898.

FOR SALE.

Manufacturing Plant with Water Power.

C. H. EVANS, Hudson, N. Y.

It Grips all shapes and Fits all Monkey Wrenches.

Steel Letters and Figures for Stamping Names and Numbers on Metals, Wood, Brass Checks, &c.
SEND FOR DESCRIPTIVE PRICE LIST.

ARTHUR STAFFORD, 37 JOHN ST., NEW YORK.

Crank Shapers.

15, 16 and 20 inch. Quick adjustment. Easy of operation. Powerful and accurate in construction.

The R. A. Kelly Machine Co.,
XENIA, OHIO, U. S. A.

If you want to hold up a light in your grinding and polishing room, send for 1898 catalog Emery Grinders.

Challenge Machine Co.,
Philadelphia, Pa.
(Desk C).

You Probably Think

because the Fellows Gear Shaper cuts accurate gears that it is slow. It's not so. We lead in quantity as well as quality, because—

Several cutter teeth are at work at once.
Cutter travels the face of work only.
Top rake to the cutter.
Work is held rigidly.
Extremely *stiff* machine.

Don't forget that "our cutter is correct."

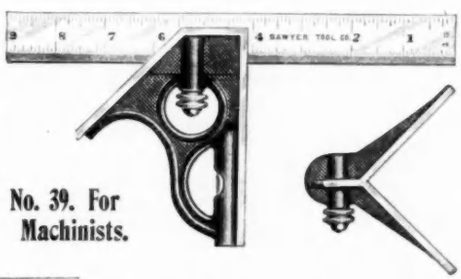
The Fellows Gear Shaper Co.,
Springfield, Vt.

Combination Squares.

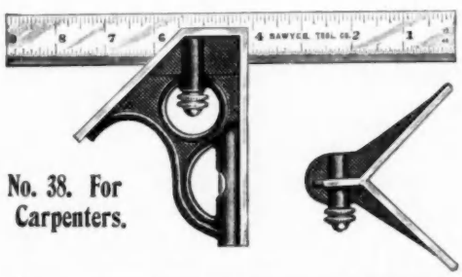
We claim for these Squares simplicity, elegance of design and finish combined with the best material and workmanship. They are made especially for machinists, who wish a tool that will wear and remain accurate. These blades are absolutely hard. The very best value for the money. Graduated in both English and Metric measure.

Price:

inch,	with center head	$2.00,	without	$1.60
"	" " "	2.25,	"	1.90
12 "	" " "	2.50,	"	2.20



No. 39. For Machinists.



No. 38. For Carpenters.

Made especially for Carpenters and Woodworkers. The blades are tempered, although they are not so hard as our No. 39. Made in three styles of graduations. No. 38 has 12ths, 48ths, 32ds and 8ths. No. 38a has No. 4 graduation. No. 38b has Metric graduation.

Price:

6 in.	with center head	$1.40,	without,	$0.95
9 "	" " "	1.65,	"	1.20
12 "	" " "	1.90,	"	1.45

New Catalogue Just Out.

Sawyer Tool Co.,
Athol, Mass., U. S. A.

company are T. Henry Dumary, of Albany, president; Chas. E. Lee, of Binghamton, vice-president and general manager, and Chas. H. Ramsey, of Howe's Cave, secretary and treasurer.

Burley Brothers contemplate the erection of a foundry at Tyrone, Pa.

The works of the Fairfield Rubber Company, Fairfield, Conn., have been destroyed by fire. Much of the machinery was practically ruined.

William Steele & Son will build a second-story addition, 48x109 feet, to the Philadelphia Textile Machine Company's plant, at the southeast corner of Palethorp and Somerset streets, Philadelphia, Pa.

The certificate of incorporation of the White Wire Company, of Rochester, N. Y., has been filed. The directors for the first year are Sidney E. White, Arthur Warren and Jacob C. Englert, all of Rochester.

At Erie, Pa., the Hays Manufacturing Company has recently been incorporated to manufacture machinery. The capital stock is $50,000 and the directors are W. B. Hays, W. H. Forster and J. B. Campbell.

The Cold Storage Warehouse Company at Front and Noble streets, Philadelphia, Pa., are having preliminary plans made by J. W. Edmundson for an eight-story brick addition to their plant, 65x145 feet in size.

The Commercial Lighting Company of New York City has been incorporated. The directors are Edmund Seymour, 35 Wall street; Jas. G. Dudley and Harry G. Strong, of New York city, and Geo. W. Titcomb, Brooklyn.

The Whitely Manufacturing Company, of Philadelphia, Pa., has been incorporated. W. N. Whitely, of Springfield, Ohio; W. F. Stillwell, Baltimore, Md., and W. W. Gibb, of Philadelphia, are among the incorporators.

The Standard Heating & Manufacturing Company, of Cleveland, Ohio, has been incorporated, and is to engage in manufacturing hot air furnaces. Geo. W. Hill, Robert L. Short, H. I. Emerson and Peter H. Gifford are the incorporators.

The United States Iron & Tin Plate Manufacturing Company, Demmler, Pa., will install five new hot mills, squaring shears and other equipment. The Riter & Conley Company will erect an additional building 100 feet long with a 49-foot span.

The Morse Wool Treating Company has just completed at Norton, Mass., an extensive plant for purifying wool. The buildings are of a substantial character, fireproof, and were designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn.

The Danville Knitting Mill Company, of Danville, Pa., intend building a new factory building at that place, to be equipped with modern machinery and power and the best appointments in all lines. It will be of brick and iron, three stories, measuring 40x80 feet.

The Metropolitan Electric Construction Company is now doing all the installation work of the Sprague Electric Company, the former company being ready to undertake as well installation of any other machinery. Its offices are in the Commercial Cable Building, New York city.

The Ludlum Steel Spring Company, Paterson, N. J., has filed a certificate of incorporation. The capital stock is $5,000, paid in by William E. Ludlum, James G. King, Rufus W. Peckham, Jr., and Daniel Warren. The company will manufacture steel railway car springs at Pompton.

The Success Machine Manufacturing Company of New York City was recently incorporated to engage in the manufacture of machinery. The directors are Wm. H. Fowler, of Stamford, Conn.; Henry C. Hulbert, Chas. F. Bassett, Chas. E. Arnold and Omri F. Hibbard, of New York city.

We Make **Boring Machines, Milling Machines, Special Tools** BEAMAN & SMITH, PROVIDENCE, R. I.

If you want a high grade

Milling Machine

write to

Kempsmith Machine Tool Co.,
Milwaukee, Wis., U. S. A.

We make them plain and universal, of quality unsurpassed. Large range of feeds, large spindle power, and all desirable conveniences.

European Agents,
Selig, Sonnenthal & Co.,
85 Queen Victoria St., London, Eng.
E. Sonnenthal, Jr.,
Neue Promenade 5, Berlin, Germany.

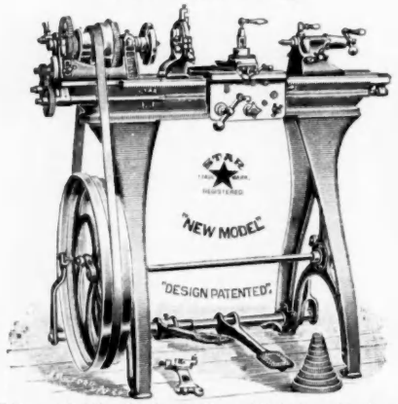
"Diamond" Grinders are all right, every time. Write for catalogue.

Diamond Machine Co.,
Providence, R. I., and Chicago, Ill.

London: Chas. Churchill & Co., Ltd.
Berlin: Garvin Machine Co.
Copenhagen: V. Lowener.
Paris: Fenwick Frères.

Star Foot Power Lathes

9 and 11 inch Swing.



Screw Cutting Engine Lathes with Automatic Cross Feed, with or without Compound Rest, Friction Countershaft, etc. Contain new and original features especially adapted for

BICYCLE, ELECTRICAL and ACCURATE MACHINE SHOP SERVICE.

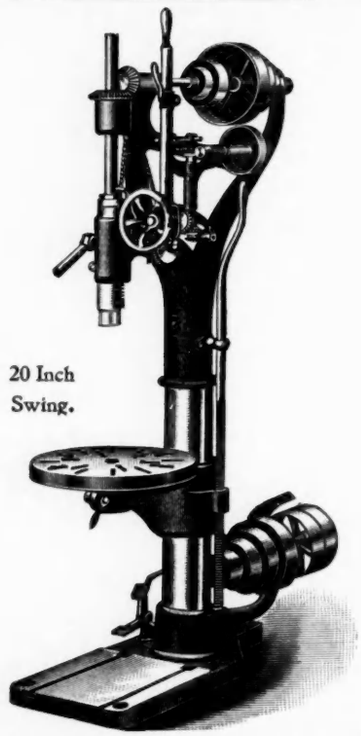
Send for Catalogue B.

SENECA FALLS MFG. CO.
687 Water St., Seneca Falls, N. Y., U. S. A.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded, on application, to the Secretary of the University.



20 Inch Swing.

We are prepared to furnish this Drill with Round or Square Slotted Tables, Lever Feed, Hand Worm Feed, Power Self-Feed, Automatic Stop and Quick Return.
All above Feeds are Combined or Single.
EQUIPPED WITH
PLAIN, FRICTION OR QUARTER-TURN COUNTERSHAFT.
Send for Catalogue.

W. F. & JOHN BARNES COMPANY,
1995 Ruby Street, ROCKFORD, ILL.
CHAS. CHURCHILL & CO., English Agents, London, E. C.

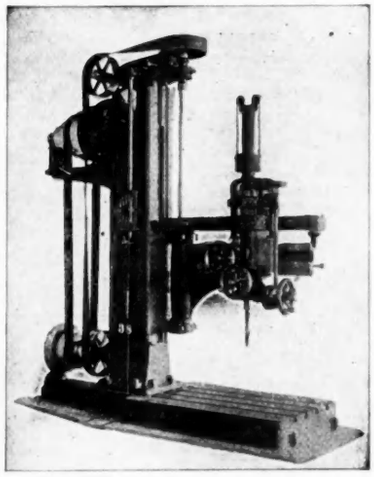
ELECTRICITY

is the most economical and convenient power for Machine Tools.

The Best Motor made is

THE "KEYSTONE"

Can be Direct Connected, Belted or Geared.
Adapted to all kinds of Machinery.
CUT SHOWS IT APPLIED TO A RADIAL DRILL.



KEYSTONE ELECTRIC CO.,
ERIE, PA., U. S. A.
NEW YORK. BOSTON. CHICAGO.

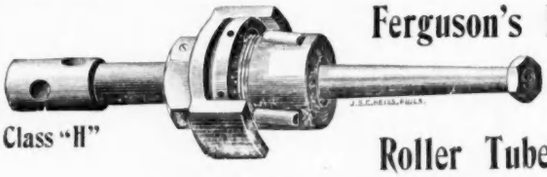
Montgomery's 1898 Tool Catalog

is ready, and **you** want it at once. It is a necessity. Over 500 pages and a discount sheet. Fully illustrated. Postpaid on receipt of 25 cents.

Montgomery & Co.,
THE TOOL DEALERS,
105 Fulton Street, - - New York City.

ISAIAH PAGE'S SONS,
ALBANY, N. Y.
Manufacturers of
Gray Iron Castings.

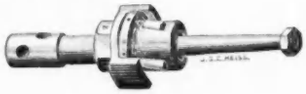
CENTURY MACHINE CO., Machinists, Manufacturers, Model Makers and Contractors.
OLUF TYBERG, Mechanical and Consulting Engineer.
Both at **576 West Broadway, New York.**
THEY WORK TOGETHER OR INDEPENDENTLY.



Ferguson's Patent
"Self Feed"
Class "H"
Roller Tube Expander.

Invented by Z. J. Ferguson, a M. M. who understood the requirements of an expander. We would like every M. M., or boss boiler maker, not familiar with the advantages of this tool, to ask for information.

A. L. Henderer's Sons, Wilmington, Del.



A. W. Secor, Agent, 123 Liberty St., New York.

Second-hand Tools.

LATHES.

12 in. x 5 ft., Reed & Prentice.
13 in. x 6 ft., Ames Manufacturing Co.'s.
14 in. x 6 ft., Lodge-Davis, Cpd. rest.
16 in. x 6 ft., Fitchburg, taper attachments.
16 in. x 7 ft., Pratt & Whitney.
18 in. x 8 ft., Flather, cpd. rest.
20 in. x 10 ft., Putnam, cpd. rest.
21 in. x 9 ft., Lodge-Davis, taper attachments.
22 in. x 10 ft., Pond, cpd. rest.
24 in. x 12 ft., Putnam, cpd. rest.
26 in. x 10 ft., Fifield, cpd. rest.
32 in. x 18 ft., Fay & Scott, cpd. rest.
40 in. x 20 ft., Pond, exra heavy.
90 in. x 20 ft., Triple geared, extra heavy.

PLANERS.

22 in. x 5 ft., Putnam.
24 in. x 6 ft. Lodge-Davis.
26 in. x 6 ft., Pond Machine Tool Co.
30 in. x 8 ft., Gray Co's. latest pattern.
36 in. x 8 ft., Bement.
38 in. x 8 ft., New Haven.
48 in. x 16 ft., Putnam.

SHAPERS.

12 in. stroke Crank, Gould & Eberhardt.
15 in. stroke Friction, Prentiss.
16 in. stroke Crank, Gould & Eberhardt.
24 in. stroke Friction, Hendey.
24 in. stroke Crank, Gould & Eberhardt.

DRILLS.

Sensitive Drills, various kinds.
20 in. Swing Barnes, hand feed.
21 in. Swing Prentiss, back geared.
22 in. Swing Barnes, back geared, automatic feed.
26 in. Swing Lodge-Davis, complete.
28 in- Swing Barnes. complete.
32 in. Swing Prentiss, complete.

RADIAL DRILLS.

72 in. Swing, complete tapping attachments.
120 in. Swing Bement Semi-Universal.
110 in. Swing, Baush, latest.

MILLING MACHINES.

Universal Kempsmith, tool size
Universal Cincinnati No. 3, back geared.
Universal Brainerd No. 15, tool size.
Plain No. 2, Kempsmith, latest.
Plain No. 12, Garvin, with arm.

SCREW MACHINES.

1 5-16 in. wire feed, Jones & Lamson, latest.
1 9-16 wire feed, Garvin, friction head and turret feed, complete.
2 1-8 in. wire-feed, Jones & Lamson, friction head and turret feed, complete.

MISCELLANEOUS.

Automatic Gear Cutter, 36 in., Gould & Eberhardt.
Cutting-off Machines, 2 and 3 in.
Bliss Press No. 19.
Stiles Presses, No. 2, 3 and 4.
Sellers Horizontal Boring and Drilling Machine.
Hilles & Jones Punch and Shears.
Bending Rolls, 6, 8 and 14 feet.

J. J. McCABE,
14 Dey Street,
NEW YORK.
Philadelphia Branch, "The Bourse."

---

8 IN. RIVET PRECISION LATHE,

with automatic cross feed compound rest, milling and grinding attachments, spring chucks, counter and other small fixtures. Used but a few weeks. Send for details.

HENRY F. HILL,
New and Second-hand Machine Tools,
122 Oliver St., Boston, Mass.

FOR SALE.

One Hornsby-Akroyd Oil Engine of 30 H. P. Has been run only a short time, and guaranteed as good as new. To be sold only for the reason that we have put in a much larger Engine, which renders its continued use unnecessary.

PORT CHESTER BOLT AND NUT CO.,
Port Chester N. Y.

FOR SALE.

One second-hand New Haven Lathe, 25 inch swing, 12 foot bed, 8½ feet between centers, with two face plates, independent chuck, steady rest and countershaft. Price, $125. In good order.

One second-hand 24 inch Putnam Planer, 6½ foot bed, cross and down power feed, countershaft and chuck; is in No. 1 order. Price, $225.

BENEDICT MFG. CO., Salamanca, New York.

FOR SALE.

54 in. x 48 in. x 24 ft. second-hand Iron Planer, made by the Hercules Iron Works, in good working order.

For particulars and specifications address

McDOWELL, STOCKER & CO.,
59-61 S. Canal St., Chicago, Ill.

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 14 in. x 3 ft. 6 in. Putnam.
5 14 in. x 6 ft. F. E. Reed.
1 15 in. x 6 ft. Star.
1 15 in. x 6 ft. Wood & Light.
1 16 in. x 5 ft. Ames.
1 16 in. x 7 ft. Dustin & Hubbard.
1 18 in. x 8 ft. Dustin & Hubbard.
1 21 in. x 9 ft. Pratt & Whitney.
1 24 in. x 13 ft. Lathe & Morse.
1 27 in. x 10 ft. Dustin & Hub.
1 28 in. x 12 ft. Wood & Light.
1 32 in. x 15 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 Pit Lathe, 72 in. x 18 ft.

PLANERS.

2 16 x 16 in. x 4 ft. Hendey.
1 24 x 24 in. x 6 ft. Powell.
1 24 x 24 in. x 7 ft. Lathe & Morse.
1 28 x 28 in. x 8 ft. G. & S.
1 30 x 30 in. x 10 ft. Niles.
1 32 x 26 in. x 14 ft. grade, 2 hds.
1 36 x 36 in. x 12 ft. Powell, 2 heads.
1 36 x 36 in. x 18 ft., Wm. Sellers.
1 48 x 32 in. x 6 ft. Pond, 2 hds.

SHAPERS.

1 9 in. Traveling Head, Wm. Sellers.
1 13 in. Traveling Head, Bement.
1 15 in. Crank Motion, Springfield.
1 15 in. Crank Motion, Kelly.

MILLING MACHINES.

2 No. 1 Garvin Universals.
1 No. 1 Cincinnati Universal.
1 No. 15 Garvin, back geared.
1 Pratt & Whitney, Grant Patent.

DRILLS.

1 24 in. Harris Bk. G'd.
1 22 in. Prentice Bk. G. & P. F.
1 3-Spindle Hendey.
1 No. 3 4-Spindle Garvin.
1 6-Spindle Quint.
4 Suspension Drills, Pond's.

SCREW AND CHUCKING MACHINES.

1 No. 2 P. & W. Wire Feed.
1 No. 2 P. & W. Plain.
1 No. 4 Windsor Plain.
1 No. 4 Windsor Wire Feed.
1 No. 4 W. & S. Bk. G'd.
1 No. 4 W. & S. and P. F.
1 No. 2 Niles, with tools.
1 18 in. P. & W. Chucking Machine.

MISCELLANEOUS.

1 51 in. Niles B. & T. Mill, 1 head.
1 3 ft. Portable Riveter.
1 Heavy Splitting Shear.
1 Whiton Centering Machine.
1 Circular Shear.
2 Garvin Cutter Grinders.
1 No. 2 Bement Hor. B. & D. Machine.
1 No. 2 Fedrick & Ayer Cyl. Borer.
1 2 in. H. & R. Cutting-off Machine.
3 Bolt Cutters, different sizes.
1 10 in. New Haven Slotter.
1 P. & W. Double Cam Cutter.

Send for Circular. Prices on application

THE NILES TOOL WORKS CO.,
138 Liberty Street, New York City.

FOR SALE:

1 Gray Lathe, 32 in. swing, 12 ft. bed.
1 Gray Lathe, 20 in. swing, 8 ft. bed.
1 Lodge & Davis, 20 in. swing, 8 ft. bed.
1 Mueller, 18 in. swing, 8 ft. bed.
1 Lodge & Davis, 14 in. swing, 8 ft. bed.
1 Milling Machine; one 18 in. Shaper.
1 Planer, Lodge & Davis, 24 x 24 x 48.
1 2 in. Pipe Cutter, 2 vertical Boring Mills.

Address: **E. W. VANDUZEN,**
104 East Second St., Cincinnati, Ohio.

Almost New Machine Tools

—AT—

SECOND-HAND PRICES.

1 Gleason Triple Geared Lathe, 72 in. x 52 ft.
1 " " " " 42 in. x 33½ ft.
1 " " " " 38 in. x 27 ft.
1 Bement-Miles Slotter, 48 in. stroke.
1 " " " 18 in. "
1 English Slotter, 14 in. stroke.
1 Gleason Planer, four heads, 72 in. x 72 in. x 12 ft.
1 " " " " 42 in. x 42 in. x 12 ft.
1 Universal Radial Drill, 5 ft. arm.
1 No. 1 Betts Horizontal Boring Machine.
1 63 in. Pond Vertical Boring Mill.
1 Morgan Electric Crane, 15 tons.
1 Brown Engine, 120 H. P.
3 Dynamos.

HILL, CLARKE & CO.

156 Oliver Street, BOSTON, MASS. | 12 South Canal Street, CHICAGO, ILL.

FOR SALE.

Manufacturing Plant with Water Power.

C. H. EVANS, Hudson, N. Y.

TO MANUFACTURERS.

A factory with railroad switch east of New Haven; cost $30,000, price $8,500; 20,000 feet floor space; 100 horse-power boiler; 85 horse-power Corliss engine; village and help; special inducements. Particulars and photographs on application. (Folio 8345).

Phillips & Wells, Tribune Building, New York.

We Have in Stock

four 16 inch x 6 feet engine lathes made by F. E. Reed & Co., with master screws, raise and fall tool rests and taper attachments, used short time but good as new. Price each, $285. Also large stock of other second-hand machinery, modern and in good condition.

J. B. DOAN & CO.,
68-70 South Canal Street, Chicago.

BARGAINS IN

NEW AND SECOND-HAND MACHINERY.

Lathes, from 12" to 48"; Planers, from 20" up to 60, 48", 54" and 60" Radial Drills; No. 2 Newton Milling Machine; No. 2 Screw Machine; Shapers, from 6" to 30", Boilermakers' Punches, Shears, Edge Planers, Rolls, Drills, Engines, Boilers, Pumps, and Dynamos.

FRANK TOOMEY, 131 N. THIRD ST., PHILA.

BARGAINS IN

MACHINE TOOLS.

No. 0. Bickford Radial Drill, with Tilting Table, used very little, practically new.

48-inch Bickford Boring and Turning Mill, A-1 order.

18-inch x 10 ft. Lodge & Shipley Lathe, with 15-inch Chuck, used very little, practically new.

18-inch x 12 ft. Lodge & Davis Lathe, chuck and blocks to raise to 22 inch. A-1 order.

30-inch x 18 ft. Fifield Lathe, with blocks to raise to 42-inch, fine condition.

No. 4. Long & Alstatter Double Punch and Shear, A-1 order.

No. 2 Cincinnati Plain Miller, plain centers and P. F. to table.

14-inch x 6 ft. Draper Lathe, R. & F. Rest (new).
14- " x 6 " Porter " " " "

CLEMENS VONNEGUT,
INDIANAPOLIS, IND.

Second-Hand Machinery

ENGINE LATHES.

No. 1 Brown & Sharpe U. H. Lathe.
11 in. x 5 ft., Prentice, R. & F. rest and turret.
15 in. x 6 ft., Reed, R. & F. rest and taper attachment.
15 in. x 6 ft., Reed.
16 in. x 6 ft., Porter, plain rest.
16 in. x 8 ft., Pratt & W., rise and fall rest.
17 in. x 6 ft., Perkins, P. C. fd.
16 in. x 8 ft., Ames, comp. rest.
26 in. Stevens Pulley Lathe.
50 in. Stephens Pulley Lathe.
2 Lodge & Davis Fox Lathes.

PLANERS.

Blaisdell Crank Planer.
20 in. x 20 in. x 6 ft. Pease.
24 in. x 24 in. x 8 ft. Fitchburg.
42 in. x 12 ft., Richards, open side; weight 42,000 lbs.

DRILL PRESSES.

12 in. Sens Prentice.
No. 2 Pratt & W., 4-spindle.
1 Pratt & W., 1-spindle, 21 in.
1 10 in. Stover, 6-spin. tur. drill.
2 3 and 4 spindle Garvin Gang Drills.
1 4-Spindle Ames.
20 in. W. & L. feed, Davis.
20 in. W. & L. feed, Barnes.
21 in. Pratt & Whitney, auto. feed, back gears.
1 7-spindle Adt. Drilling and Countersinking Machine.
2 22 1-2 in. Barnes, W. & L. feed, back gears, auto. feed and trip.
3-spindle Baker Drill.
9 foot Holly Radial Drill.

MILLING MACHINES.

No. 2 Kempsmith.
No. 3 Kempsmith.
No. 2 Garvin, plain.
No. 4 Garvin Bk. Fd. without arm.
50 in. Brainerd Keyseater.
Pratt & Whitney, Circular Miller.

SCREW MACHINES.

1 21 in. x 6 ft. Flather turret lathe, back gears and auto. feed to turret.
1 14 in. Garvin turret lathe, with pan.
1 Garvin No. 1, wire feed.
2 Garvin No. 2 1-2, wire feed.
1 No. 2 Pratt & Whitney, plain.
1 No. 2 1-2 Pratt & Whitney, 2 chucks.
1 No. 2 Windsor, w. f., chasing bar and tools.
No. 3 Brown & Sharpe.
1 No. 4 Warner & Swasey, geared fric. head, oil pump and 2 jaw chuck.
1 x 8 Jones & Lamson, plain, with 2 jaw chuck.
2 Pratt & W. Hub Machines, geared fric. head, oil pump and 2 jaw chucks.

SHAPERS.

10 in. Gould & Eberhardt.
18 in. Wood & Light, traverse
12 in. crank, Juengst.
15 in. Hendey, Friction.
16 in. crank, Gould & Eberhardt.

MISCELLANEOUS.

2 H. P. Nash Gas Engine, with sound deadener, gas bags, etc.; 1 No. 2 Garvin Auto. Tapper; 1 Garvin Boring Mill; 1 40 in. Boring and Turning Mill, 1 Head, new; 1 Amer. Gas Furnace; 1 Dienelt & Eisenhardt Hammer; 1 28 x 16 x 52 in. Springfield Surface Grinder; 1 Cincinnati Cutter Grinder; 1 Garvin 1-Spindle Profiler; No. 2 Stiles Press; No. 3 Pratt & Whitney Horizontal Tapper; 1 No. 3 Garvin Cut. Grinder. Write for our Complete List No. 20, showing a large stock of New and Second-Hand Machinery, ready for immediate delivery.

250 New Machine Tools in Our Store.

The Garvin Machine Co.,

Spring and Varick Streets, . NEW YORK.

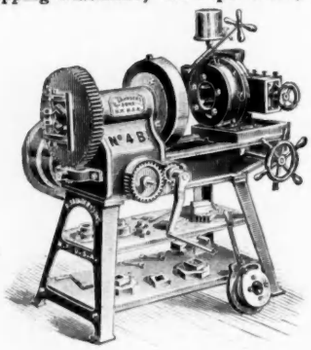
Philadelphia Store: 51 N. 7th St., Philadelphia, Pa.

D. SAUNDERS' SONS,

MANUFACTURERS OF

Pipe Cutting and Threading Machines

Steam and Gas Fitters' Hand Tools,
Tapping Machinery for Pipe Work, Etc.



The No. 4 B Machine for Cutting and Threading Pipe ½ to 4 in., by HAND or POWER.

Send for Catalogue to

21 Atherton Street, YONKERS, N. Y.

CENTURY MACHINE CO., Machinists, Manufacturers, Model Makers and Contractors.

OLUF TYBERG, Mechanical and Consulting Engineer.

Both at **576 West Broadway, New York.**

THEY WORK TOGETHER OR INDEPENDENTLY.

ELECTRICITY

is the most economical and convenient power for Machine Tools.

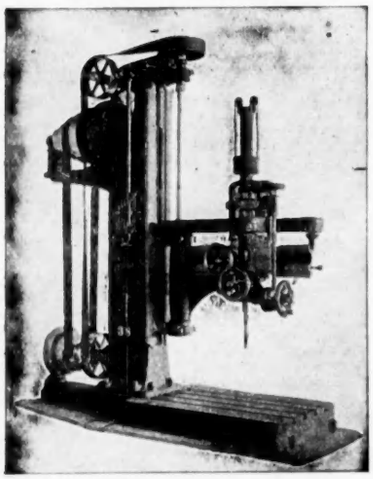
The Best Motor made is

THE "KEYSTONE"

Can be Direct Connected,
Belted or Geared.

Adapted to all kinds of Machinery.

CUT SHOWS IT APPLIED TO A RADIAL DRILL.



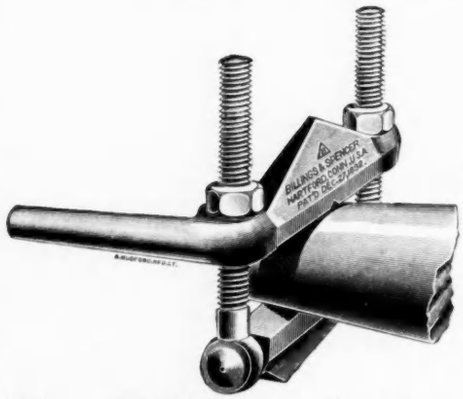
KEYSTONE ELECTRIC CO.,

ERIE, PA., U. S. A.

NEW YORK. BOSTON. CHICAGO.

Something New.

SWIVEL JAW CLAMP DOG.



No. 1—1¾ inches between Screws.
No. 2—2¼ " " "
No. 3—2¾ " " "

Drop Forgings of every description.

DROP FORGING PLANTS
AND
MACHINISTS' TOOLS

The Billings & Spencer Co.,

HARTFORD, CONN., U. S. A.

BARNES'

UPRIGHT DRILLS.

COMPLETE LINE, ranging from Light Friction Disk Drill to 42-in. Back Geared and Self-Feed. **THIS CUT** represents our 22½ in. Swing Drill. We are prepared to furnish it with or without Back Gear; with or without Self-Feed. The **SELF-FEED** arrangement on this Drill gives the operator the choice of five feeds:

LEVER FEED,
HAND and WORM FEED,
POWER SELF-FEED,
AUTOMATIC STOP,
QUICK RETURN.

SEND FOR CATALOGUE,
giving full description of all our Drills.

W. F. & Jno. Barnes Co.

1995 Ruby Street,
ROCKFORD,
ILL.

CHAS. CHURCHILL & CO., English Agents, London, E. C.

FENWICK FRERES & CO., Paris.

GUSTAV DIECHMAN & SOHN, Berlin.

C. S. CHRISTENSON, Christiania.

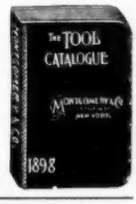
BOOKS for MACHINISTS, Engineers, Electricians and Practical Men. **Mailed Free.** 96-page Catalogue of Practical Books. Address Norman E. Henley & Co., 132 Nassau St., New York.

The Fulton Multiple Arbor Grinding Head.

This tool has been designed to meet the requirements of those who need several wheels of different shapes for grinding small tools. The usual practice, where a change of form is required, is to remove the wheel from the arbor and substitute another; with the result that the substituted wheel will not run true.

Price, $7.00 Each. Circular Free.

Have you seen our 1898 catalog? It is over 500 pages, with discount sheet. Sent on receipt of 25c.



Montgomery & Co.,

THE TOOL DEALERS,

105 Fulton Street, - New York City.

Jacks

The Henderer Jacks are good jacks, honestly made from good material, subjected to severe tests and guaranteed for hard work.

A. L. HENDERER'S SONS,

Wilmington, Del., U. S. A.

A. W. Secor, Agent, 123 Liberty Street, New York.

A 13-inch Single Spindle Sensitive Drill

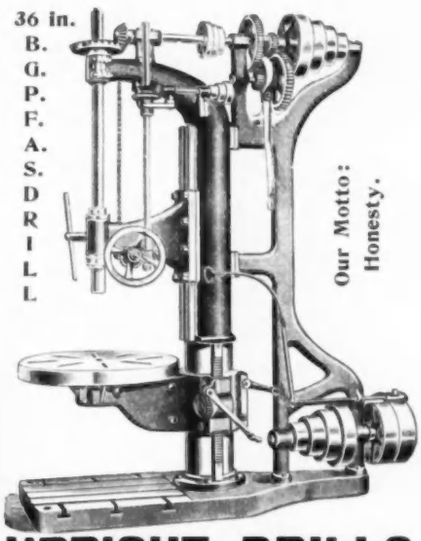
For tool making and general machine shop work, at a special price of

$50.00.

This machine is for drilling up to 1½ inches. Has a much greater capacity and wider range of work than our little $20,00 Drill shown last month. All particulars and description for the asking.

D'Amour & Littledale, 204 East 43d Street, New York City.

36 in. B. G. P. F. A. S. DRILL



Our Motto: Honesty.

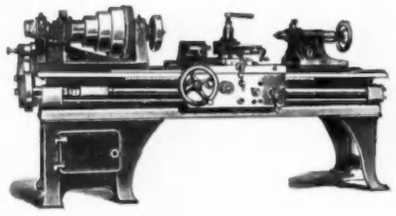
UPRIGHT DRILLS

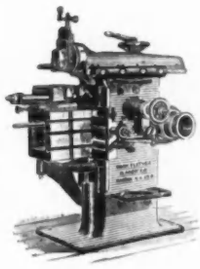
OUR SPECIALTY, AND NOTHING ELSE.

How easy it is to deceive most people, and how slow many of the keenest men are to accept facts. It has been my motto in years past, and is to-day, to give every purchaser of my drills full value for his money. The world-wide reputation which my tools have to-day has been obtained by having every drill sold, up to the standard. The largest and most up to date firms are buying from me. Send for list of users and Catalogue.

J. E. SNYDER,

Worcester, Mass., U. S. A.





When You Buy

Lathes or Shapers, age, reputation and responsbility of the maker must be taken into consideration and full credit given to years of experience and knowledge of what's best. Flather Tools have been good tools for twenty-five years.

Flather & Co., Nashua, N. H., U. S. A.

Agents:

Hill, Clarke & Co., Boston and Chicago.
Niles Tool Works, New York.
Garvin Machine Co., New York and Philadelphia.
Chas. Churchill & Co., London.
Adolphe Janssens, Paris.
V. Lowener, Copenhagen.

MILL AND CUTTER GRINDER.

With this machine Cutters, Taps, Reamers, Lathe Tools, etc., can be ground. Cutters to 6 inches in diameter; both spiral or straight Reamers 14 inches and less in length.

IS ARRANGED FOR TWO WHEELS.

A Machine needed in every Tool Room.

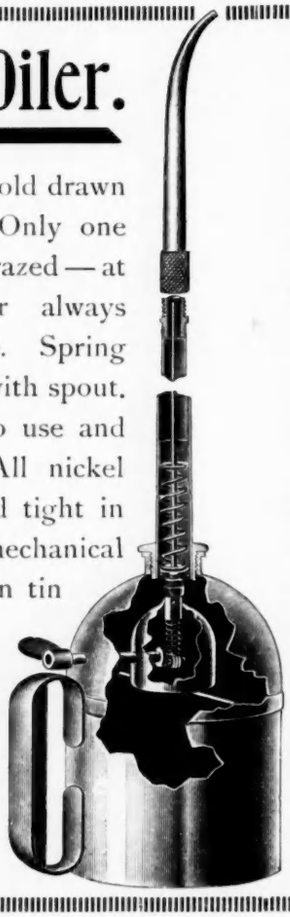
Price, complete with overhead work,

$62.00.

WELLS BROS. & CO., Greenfield, Mass., Makers.

McVicar Oiler.

Made of 22-gage cold drawn steel throughout. Only one seam — and that brazed — at top. Air chamber always open to atmosphere. Spring and valve come off with spout. Easy to fill, easy to use and hard to misuse. All nickel plated. Guaranteed tight in any position. A mechanical job. Last life of ten tin cans.



McVICAR & SWEET,

Equitable Bldg.,

DENVER, COL.

Two Kinds of Men.

Some men won't advertise when they are busy—think it will last forever.

• • •

They won't advertise when times are dull—think the crack of doom is just about to the city line.

• • •

There are others who advertise all the time.

• • •

The latter attract inquiries and orders, and in good times can pick what they want.

• • •

In dull times they get all there is going—the other fellow is out of business.

• • •

One is an optimist in prosperity, a pessimist in adversity, and a narrow-gage weakling all the time.

• • •

The other is just a plain, common-sense business man.

• • •

What kind are you?

American Machinist,

256 Broadway, New York.

HAVE YOU SEEN OUR 1898 CATALOGUE?

MORSE TWIST DRILL AND MACHINE CO.,
NEW BEDFORD, MASS.

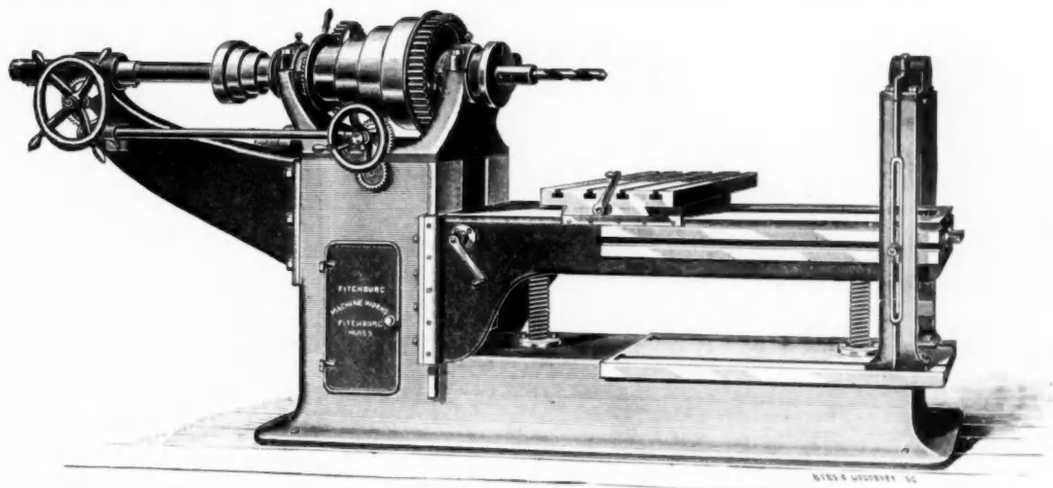
FITCHBURG MACHINE WORKS,

Fitchburg, Mass., U. S. A.

"Constantly 'Hustling' Brings Success." We have been "hustling" for 34 years and are ever producing HONEST MACHINE TOOLS, WHICH LEAD. Send for "Flyers."

FITCHBURG LATHES, 14 to 72 inch swing, inclusive; FITCHBURG PLANERS, 18 to 72 inches square, inclusive; FITCHBURG SHAPERS, 14 and 18 inch stroke; FITCHBURG UPRIGHT DRILLS, 18 to 42 inch table; FITCHBURG TOOL-ROOM LATHES; FITCHBURG PATTERN MAKERS' LATHES.

HORIZONTAL BORING AND DRILLING MACHINES; RADIAL DRILLS, 6 and 7 feet arms; COUNTERSINKING AND DRILLING MACHINES, 15 feet arm, driven by electric motor or otherwise, for boiler and bridge makers; THE GEM LATHES, 14 inch swing. Sell fast. Send for "Honest Facts."



HORIZONTAL BORING AND DRILLING MACHINE—40 INCHES.

WE SELL DIRECT.

SELLING OFFICES:
Main Office, Works and Warerooms, Fitchburg, Mass.
Philadelphia Office, 383 The Bourse.

FOR FOREIGN COUNTRIES:
Great Britain—Richard Lloyd & Co., Birmingham.
Denmark, Norway and Sweden—V. Lowener, Copenhagen.
Germany, Austria, France and Russia—Markt & Co., Ltd.

The name of
WESTINGHOUSE
is a guarantee.

Westinghouse
Electric & Mfg. Co.
Pittsburgh, Pa.
Westinghouse
Electric.

Wurts Lightning Arresters.

For Alternating Current and Direct Current Circuits,
The only Sure Protection for Electric Plants.

Spell it

Wurts. The u is important. Remember that.

New York, Boston, Chicago, Philadelphia, St. Louis, San Francisco, Buffalo, Syracuse, Atlanta, Tacoma, Mountain Electric Co., Denver. For Canada, Ahearn & Soper, Ottawa. Westinghouse Electric Co., Ltd., 32 Victoria St., London.

14-INCH SLOTTER.

MACHINE TOOLS OF ALL TYPES AND SIZES

. . . Patterns for 300 Different Types.

Photographs and Descriptions on Application.

THE NILES TOOL WORKS CO.,

Hamilton, Ohio.

NEW YORK. CHICAGO. PITTSBURGH. PHILADELPHIA. BOSTON. ST. LOUIS.

GREAT BRITAIN: 39 Victoria St., London, S. W.

3-SPINDLE RAIL DRILL.

The G. A. Gray Co., Cincinnati, Ohio,

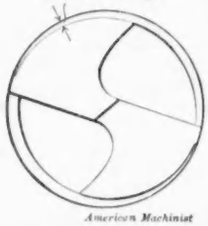
call attention to the fact that one of their electrically driven, direct-connected, spiral geared planers (with 4 heads) may be seen in operation in Machinery Hall of the Philadelphia Bourse Exposition. Open daily and Wednesday evenings. Admission free.

You Know!

that we inaugurated **THE MODERN SYSTEM** of automatically shaping and grinding **LATHE, PLANER** and other **CUTTING TOOLS,** and that we invented the machines to do this work. The average wages cost at our establishment for shaping and grinding all tools upon our **TOOL GRINDING MACHINES** is **LESS THAN 3-4 OF 1 CENT PER TOOL!** Illustrated pamphlet sent on request.

William Sellers & Co. Incorp. **PHILADELPHIA.**

½ Degree Angle

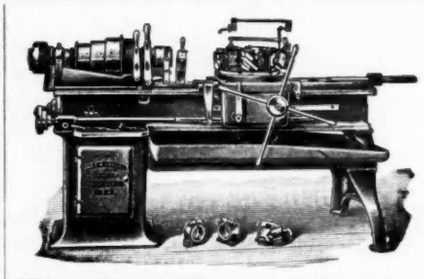


American Machinist

"Constant Angle" Twist Drills.

The manner in which "Constant Angle" Twist Drills are body cleared distinguishes them. This clearance is milled, not ground, and is uniform for all sizes, one-half degree circular angle. This is one reason why they work so satisfactorily in drilling deep holes. Catalogue free.

The T. & B. Tool Co., Danbury, Conn., U. S. A.



The Flat Turret Lathe

Does Lathe work accurately up to 2 in. diameter by 24 in. long.

Jones & Lamson Machine Co.,

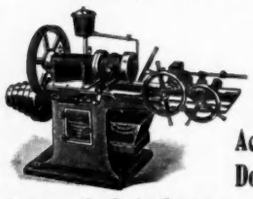
Springfield, Vt., U. S. A.

Selling Agent for Germany, Switzerland, Austria-Hungary, Russia, Holland and Belgium: M. KOYEMANN, Charlottenstrasse, 112, Dusseldorf, Germany.

England: HENRY KELLEY & CO., 26 Pall Mall, Manchester.

The Acme Machinery Co.,

CLEVELAND, O.,



Manufacturers of

Acme Bolt and Rivet Headers.

Acme Single, Double and Triple Automatic Bolt Cutters.

Cutting from 1-8 in. to 6 in. Diameter.

Also Separate Heads and Dies.

SET AND CAP SCREWS

STUDS — **NUTS**

CINCINNATI SCREW & TAP CO.

STANDARD AND SPECIALS.

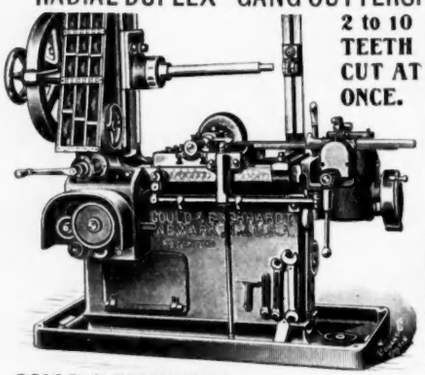
CINCINNATI, O., U. S. A.

FOR ENGINES AND MACHINERY.

Patent Entirely Automatic

GEAR CUTTERS & "RADIAL DUPLEX" GANG CUTTERS.

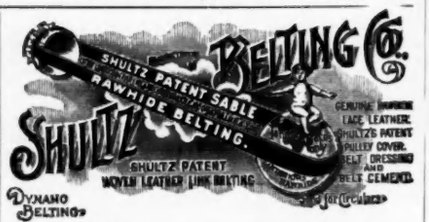
2 to 10 TEETH CUT AT ONCE.



GOULD & EBERHARDT,

NEWARK, NEW JERSEY, U. S. A.

Foreign Agents: JOHN LANG & SONS, Johnstone, Scotland. SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels. G. KOEPPEN & Co., Moscow, Russia, Shaper Agents. WHITE, CHILD & BENEY, Vienna, Aus., Shaper Agts.


SHULTZ BELTING CO.
SHULTZ PATENT SABLE RAWHIDE BELTING.
SHULTZ
SHULTZ PATENT WOVEN LEATHER LINK BELTING
GENUINE IMPROVED LACE LEATHER. SHULTZ'S PATENT PULLEY COVER. BELT DRESSING AND BELT CEMENT.
DYNAMO BELTING

EXPORT TRADE A SPECIALTY. ST. LOUIS, MO.

ELECTRIC CRANES. DYNAMOS and MOTORS.

PAWLING & HARNISCHFEGER,

163 Clinton St., Milwaukee, Wis.

Chicago Office: G. P. NICHOLS & BRO., Managers, 1325 Monadnock Bldg.

THE GILLETTE-HERZOG MANUFACTURING CO.,

Sole Agents Northwestern States. Minneapolis, Minn.

GRANT GEARS

GEAR WHEEL CUTTING.

GRANT GEAR WORKS,

626 Race Street, PHILADELPHIA.

6 Portland Street, BOSTON.

86 Seneca Street, CLEVELAND.

Send for Catalog.

FINE TOOL MAKING and SUB-PRESS WORK.

Write A. F. INESON, WATERBURY, CONN., U. S. A.

PLANED BEVEL GEARS

MACHINE MOULDED GEARS.

Gears up to 12 Feet Diameter.

GLEASON TOOL CO.

Mfrs. LATHES and GEAR PLANERS.

8 Race St., Rochester, N. Y.